

U. S. Circuit Court of Appeals for the Seventh  
District. October Term, 1902

No. 974 National Phonograph Co. vs.  
Lambert Co. and Thomas B. Lambert.

No. 975 Lambert Co. and Thomas B. Lambert  
vs. Edison Phonograph Co.

TRANSCRIPT OF RECORD - Appeal from the Circuit  
Court of the United States for the Northern  
District of Illinois, Northern Division  
1903



TRANSCRIPT OF RECORD.

IN THE  
UNITED STATES CIRCUIT COURT OF APPEALS  
FOR THE SEVENTH CIRCUIT

OCTOBER TERM, A. D. 1902

No. 974.

NATIONAL PHONOGRAPH COMPANY,

*Appellant.*

vs.

LAMBERT COMPANY AND THOMAS B. LAMBERT,

*Appellees.*

No. 975.

LAMBERT COMPANY AND THOMAS B. LAMBERT,

*Appellants.*

FOREIGN PHONOGRAPH COMPANY,

*Appellee.*

MR. RICHARD M.

MR. WILLIAM H. DE GEE,

MR. GEORGE E. PORTER,

MR. GUYLL MOFFETT,

*Counsel for National Phonograph Co. and*

*Foreign Phonograph Co.*

MR. THOMAS F. SHERIDAN,

*Counsel for Appellees.*

Appeal from the Circuit Court of  
the District of Columbia.

and States for the Northern District of  
California.

TRANSCRIPT OF  
THE

FILED MAY 2, 1903  
RECORD.



IN THE  
UNITED STATES CIRCUIT COURT OF APPEALS  
FOR THE SEVENTH CIRCUIT.

OCTOBER TERM, A. D. 1902.

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No. 974.

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NATIONAL PHONOGRAPH COMPANY,  
*Appellant,*

*vs.*

LAMBERT COMPANY AND THOMAS B. LAMBERT,  
*Appellees.*

No. 975.

LAMBERT COMPANY AND THOMAS B. LAMBERT,  
*Appellants,*

*vs.*

EDISON PHONOGRAPH COMPANY,  
*Appellees.*

---

MR. RICHARD N. DYER,  
MR. WILLIAM G. BEALE,  
MR. GILBERT E. PORTER,  
MR. BUELL MCKEEVER,

*Counsel for National Phonograph Co. and  
Edison Phonograph Co.*

MR. THOMAS F. SHERIDAN,  
*Counsel for Appellees.*

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Appeal from the Circuit Court of the United States for the Northern District of  
Illinois, Northern Division.



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Pleas in the Circuit Court of the United States for the Northern District of Illinois—Northern Division, in Chancery sitting at the United States Court room, in the City of Chicago, in said District and Division, before the Honorable Christian C. Kohlsaat, District Judge, of the United States for said Northern District of Illinois, on Tuesday, the twenty fourth day of February, in the year of our Lord one thousand nine hundred and three, being one of the days of the regular December term of said Court, 1902 and of our independence the one hundred and twenty seventh year.

MARSHALL E. SAMPSELL,  
*Clerk.*

National Phonograph Company,	}	25789
<i>vs.</i>		
Lambert Company and Thomas B. Lambert.		

Edison Phonograph Company,	}	25789 8
<i>vs.</i>		
Lambert Company and Thomas B. Lambert.		





TO THE HONORABLE THE JUDGES OF THE UNITED STATES  
CIRCUIT COURT FOR THE NORTHERN DISTRICT OF  
ILLINOIS, NORTHERN DIVISION.

National Phonograph Company, a corporation organized and existing under and by virtue of the laws of the State of New Jersey and having its principal place of business at Orange, in the County of Essex and State of New Jersey, brings this, its bill of complaint, against Lambert Company, a corporation organized and existing under and by virtue of the laws of the State of Illinois and having its principal place of business in the City of Chicago in said State, and Thomas B. Lambert, a resident of and having a regular and established place of business in the said City of Chicago, in the State of Illinois, individually, and as an official of the said Lambert Company.

And thereupon your orator complains and says:

I. That heretofore and before the 12th day of November, 1889, Thomas A. Edison, being then, as now, a resident of Llewellyn Park in the County of Essex and State of New Jersey, and a citizen of said State, was the original, first and sole inventor of certain new and useful improvements in phonogram blanks, fully described in the letters patent hereinafter mentioned, and which had not been known or used by others in this country, and which had not been abandoned nor patented or described in any printed publication in this or any foreign country, before his invention thereof, and which were not, prior to his application for letters patent therefor, as hereinafter mentioned, in public use or on sale in this country for more than two years.

II. That the said Edison, being so as aforesaid the first inventor and discoverer of the said improvements,



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made application in writing to the Commissioner of Patents of the United States for the grant of letters patent therefor, and paid into the Treasury of the United States the fees required by law, and then and there fully and in all respects complied with all the necessary conditions and requirements of the statutes of the United States in such case made and provided, and thereupon, after due examination having been made by the Commissioner of Patents as to the novelty

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and utility of the said invention, as provided by law, the Commissioner of Patents caused to be issued to the said Edison letters patent in due form of law, under the seal of the Patent Office of the United States, signed by the Secretary of the Interior and countersigned by the Commissioner of Patents, and bearing date the said 12th day of November, 1889, and numbered 414,761, and that the said letters patent did grant unto the said Edison, and unto his heirs and assigns, for the term of seventeen years from the date

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thereof, the exclusive right to make, use and vend the said invention throughout the United States and the Territories thereof, as by said letters patent or a duly authenticated copy thereof in Court to be produced will more fully and at large appear.

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III. That heretofore and before the commission by the defendants of the acts hereinafter complained of, your orator became, by virtue of mesne assignments in writing duly executed and delivered and recorded in the Patent Office of the United States, vested with the full and entire right, title and interest in and to said letters patent numbered 414,761, and that it has ever since been and now is possessed of the same.

IV. That your orator is engaged in the manufacture and sale of phonographs and supplies therefor, and that in carrying on its business it has manufactured and is manufacturing in large quantities phonogram-blanks employing and containing the invention described and claimed in and by said letters patent ; that it has in-

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vested and expended large sums of money and has been to great trouble in and about the said invention, for the purpose of introducing the same and making the same profitable to itself and to the public; that phonogram-blanks employing and containing the invention patented as aforesaid have been in great demand and are of great benefit and advantage to your orator and to the public, and that the public has generally acknowledged and acquiesced in the rights of your orator, and your orator believes that it will realize and receive large gains and profits therefrom if infringement by the said defendants and their confederates shall be prevented.

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V. That, on information and belief, phonogram-blanks heretofore, and now being, placed upon the market by your orator and its predecessors in the title to said letters patent and made under and in accordance with the said letters patent have been duly marked with the word "Patented," together with the date of said letters patent as aforesaid, and further your orator avers, on information and belief, that the defendants were duly notified of the said letters patent and of the infringement hereinafter charged, but that they continued after such notice to make and use phonogram-blanks embodying the said invention.

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VI. That the defendants, well knowing the premises and the rights secured to your orator as aforesaid but contriving to injure it and to deprive it of the benefits and advantages which might and otherwise would accrue unto it from the said invention, did, after the grant of said letters patent and after the acquiring by your orator of its exclusive rights therein and before the commencement of this suit, as your orator is informed and believes, within the Northern District of Illinois, Northern Division, aforesaid, and elsewhere in the United States, without license or allowance and against the will of your orator and in violation of its

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rights, jointly and severally, unlawfully and wrongfully make, use and sell or cause to be made, used and sold, and are now making, using and selling or causing to be made, used and sold, phonogram-blanks employing and containing the invention set forth in said letters patent, that they still continue so to do, and that they are threatening to continue the aforesaid unlawful acts to a large extent, all in defiance of the rights secured to your orator as aforesaid and to its

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great and irreparable loss and injury, and by which it has been and still is being deprived of great gains and profits which it might and otherwise would have obtained but which have been received and enjoyed by the said defendants through their said unlawful acts and doings. And your orator further shows that as to how many phonogram-blanks by the defendants, as aforesaid, unlawfully made or used or sold, and as to the extent of the gains and profits received and enjoyed by them from such unlawful making or using or selling,

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your orator is ignorant and prays a discovery thereof.

VII. That the manufacture, use and sale of phonogram-blanks employing and containing the said invention set forth in said letters patent by the said defendants and their preparation for and avowed determination to continue the same and their other aforesaid unlawful acts, in disregard and defiance of the rights of your orator, have the effect to and do encourage and induce

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others to venture to infringe said letters patent.

VIII. Your orator therefore prays that the said defendants Lambert Company and Thomas B. Lambert individually and as an official of the said Lambert Company, and their officers, servants, agents, attorneys, employees, workmen and confederates, and each and every of them, may be perpetually restrained and enjoined by the order and injunction of this Honorable Court from directly or indirectly making, constructing, using, vending, delivering, working or putting into

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operation or use, or in any wise counterfeiting or imitating, the said invention or any phonogram blanks made or operated in accordance therewith or like or similar to those which the said defendants have heretofore made, sold, constructed, operated or used, and that the said defendants may be decreed to pay the costs of this suit, and that your orator may have such other and further relief as to this Honorable Court shall seem meet and shall be agreeable to equity.

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IX. Your orator further prays than an injunction *pendente lite* be granted, issuing out of and under the seal of this Honorable Court, enjoining and restraining the said defendants and their officers, servants, agents, attorneys, employees, workmen and confederates, and each and every of them, to the same purport and tenor and effect as hereinbefore prayed for with regard to said perpetual injunction.

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X. And forasmuch as your orator can have no adequate relief save in this Court, to the end therefore that the said defendants may, if they can, show why your orator should not have the relief hereby prayed and may, but not upon oath, an answer under oath being hereby expressly waived, according to their best and utmost knowledge, remembrance, information and belief, and according to the best and utmost knowledge, remembrance, information and belief of the officers of the said defendant Lambert Company, full, true, direct and perfect answer make to the premises and to all the several matters hereinbefore stated and charged, as fully and particularly as if severally and separately interrogated as to each and every of said matters, and may be compelled to account for and pay to your orator the profits by them acquired and the damages suffered by your orator from the aforesaid unlawful acts, and that the Court may assess said profits and damages and may increase the damages to a sum not exceeding three times the amount thereof.

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May it please your Honors to grant unto your orator the writ of subpoena issuing out of and under the seal of this Honorable Court, directed to the said defendants Lambert Company and Thomas B. Lambert, individually and as an official of the said Lambert Company, commanding them and each of them, by a certain day and under a certain penalty, to be and appear in this Honorable Court, then and there to answer to the premises and to stand to and abide such order and decree as may be made against them.

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And your orator will ever pray.

NATIONAL PHONOGRAPH CO.

By WILLIAM E. GILMORE,

President.

ISHAM, LINCOLN & BEALE,

Solicitors for Complainant.

RICHARD N. DYER,

Of Counsel for Complainant.

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STATE OF NEW JERSEY, }  
County of Essex, } ss.:

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WILLIAM E. GILMORE, being duly sworn, deposes and says that he is the president of National Phonograph Company, the complainant named in the foregoing bill of complaint; that he has read the said bill and knows the contents thereof; that the same is true to his own knowledge, save as to the matters therein stated to be alleged on information and belief, and as to those matters he believes it to be true; and that he verily believes Thomas A. Edison to be the first, original and sole inventor of the improvements in phonogram blanks set forth in Letters Patent No. 414,761, referred to in the said bill of complaint.

WILLIAM E. GILMORE.

Subscribed and sworn to before me this 29th day of December, 1900.

J. F. RANDOLPH,

[SEAL.]

Notary Public for New Jersey.

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TO THE HONORABLE THE JUDGES OF THE UNITED STATES  
CIRCUIT COURT FOR THE NORTHERN DISTRICT OF  
ILLINOIS, NORTHERN DIVISION :

Edison Phonograph Company, a corporation organized and existing under and by virtue of the laws of the State of New Jersey and having its principal place of business at Orange, in the County of Essex and State of New Jersey, brings this its bill of complaint against Lambert Company, a corporation organized and existing under and by virtue of the laws of the State of Illinois and having its principal place of business in the City of Chicago in said State, and Thomas B. Lambert, a resident of and having a regular and established place of business in the said City of Chicago in the State of Illinois, individually and as an official of the said Lambert Company.

And thereupon your orator complains and says :

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I. That heretofore and before the 8th day of May, 1888, Thomas A. Edison, being then, as now, a resident of Llewellyn Park in the County of Essex and State of New Jersey, and a citizen of said State, was the original, first and sole inventor of certain new and useful improvements in phonogram-blanks, fully described in the letters patent hereinafter mentioned, and which had not been known or used by others in this country and which had not been abandoned nor patented or described in any printed publication in this or any foreign country, before his invention thereof, and which were not, prior to his application for letters patent therefor, as hereinafter mentioned, in public use or on sale in this country for more than two years.

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II. That the said Edison, being so as aforesaid the first inventor and discoverer of the said improvements, made application in writing to the Commissioner of Patents of the United States for the grant of letters patent therefor, and



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paid into the Treasury of the United States the fees required by law, and then and there fully and in all respects complied with all the necessary conditions and requirements of the statutes of the United States in such case made and provided, and thereupon, after due examination having been made by the Commissioner of Patents as to the novelty and utility of the said invention, as provided by law, the Commissioner of Patents caused to be issued to the said Edison letters patent in due form of law, under the seal of the Patent Office of the United States, signed by the Secretary of the Interior and countersigned by the Commissioner of Patents and bearing date the said 8th day of May, 1888, and numbered 382,418, and that the said letters patent did grant unto the said Edison and unto his heirs and assigns, for the term of seventeen years from the date thereof, the exclusive right to make, use and vend the said invention throughout the United States and the territories thereof, as by said letters patent or a duly authenticated copy thereof in Court to be produced will more fully and at large appear.

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III. That heretofore and before the said 8th day of May, 1888, the said Thomas A. Edison, being then, as now, a resident of Llewellyn Park, in the County of Essex and State of New Jersey, and a citizen of said State, was the original, first and sole inventor of certain other new and useful improvements in phonogram blanks, fully described in the letters patent hereinafter mentioned, and which had not been known or used by others in this country, and which had not been abandoned nor patented or described in any printed publication in this or any foreign country, before his invention thereof, and which were not, prior to his application for letters patent therefor as hereinafter mentioned, in public use or on sale in this country for more than two years.

IV. That the said Edison, being so as aforesaid the first inventor and discoverer of the said improvements,

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made application in writing to the Commissioner of Patents of the United States for the grant of letters therefor, and paid into the Treasury of the United States the fees required by law, and then and there fully and in all respects complied with all the necessary conditions and requirements of the statutes of the United States in such case made and provided, and thereupon, after due examination having been made by the Commissioner of Patents as to the novelty and utility of the said invention, as provided by law, the Commissioner of Patents caused to be issued to the said Edison letters patent in due form of law, under the seal of the Patent Office of the United States, signed by the Secretary of the Interior and countersigned by the Commissioner of Patents and bearing date the said 8th day of May, 1888, and numbered 382,462, and that the said letters patent did grant unto the said Edison and unto his heirs and assigns, for the term of seventeen years from the date thereof, the exclusive right to make, use and vend the said invention throughout the United States and the Territories thereof, as by said letters patent or a duly authenticated copy thereof in Court to be produced will more fully and at large appear.

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V. That heretofore and before the commission by the defendants of the acts hereinafter complained of, your orator became, by virtue of an assignment in writing duly executed and delivered and recorded in the Patent Office of the United States, vested with the full and entire right, title and interest in and to said Letters Patent numbered 382,418 and 382,462, and each and every of them, and that it has ever since been and now is possessed of the same.

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VI. That the inventions described and claimed in said several letters patent are capable of conjoint use in one and the same apparatus, and that in the apparatus herein complained of they are, in fact, so conjointly used.



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VII. That your orator is engaged in the manufacture and sale of phonographs and supplies therefor, and that in carrying on its business it has manufactured, and is manufacturing in large quantities, phonogram blanks employing and containing the several inventions described and claimed in and by said several letters patent; that it has invested and expended large sums of money, and has been to great trouble in and about the said several inventions for the purpose of introducing the same and making the same profitable to itself and to the public; that phonogram blanks employing and containing the several inventions patented as aforesaid have been in great demand, and are of great benefit and advantage to your orator and to the public, and that the public has generally acknowledged and acquiesced in the rights of your orator, and your orator believes that it will realize and receive large gains and profits therefrom if infringement by the said defendants and their confederates shall be prevented.

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VIII. Your orator avers, on information and belief, that phonogram blanks heretofore and now being placed upon the market by your orator and its predecessors in the title to said several letters patent, and made under and in accordance with the said several letters patent have been duly marked with the word "Patented," together with the respective dates of said letters patent as aforesaid; and further, your orator avers on information and belief, that the defendants were duly notified of the said several letters patent and of the infringement hereinafter charged, but that they continued after such notice to make and use phonogram blanks embodying the said several inventions.

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IX. That the defendants, well knowing the premises and the rights secured to your orator as aforesaid, but contriving to injure it and to deprive it of the benefits and advantages which might and otherwise would accrue unto it from the said several inventions, did, after



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the grant of said several letters patent and after the acquiring by your orator of its exclusive rights therein and before the commencement of this suit, as your orator is informed and believes, within the Northern District of Illinois, Northern Division aforesaid, and elsewhere in the United States, without licence or allowance and against the will of your orator and in violation of its rights, jointly and severally, unlawfully and wrongfully make, use and sell, or cause to be made, used or sold, and are now making, using and selling, or causing to be made, used and sold, phonogram blanks employing and containing the several inventions set forth in said several letters patent; that they still continue so to do, and that they are threatening to continue the aforesaid unlawful acts to a large extent, all in defiance of the rights secured to your orator as aforesaid and to its great and irreparable loss and injury, and by which it has been and still is being deprived of great gains and profits which it might and otherwise would have obtained, but which have been received and enjoyed by the said defendants through their said unlawful acts and doings. And your orator further shows that as to how many phonogram blanks by the defendants as aforesaid unlawfully made or used or sold, and as to the extent of the gains and profits received and enjoyed by them from such unlawful making or using or selling, your orator is ignorant and prays a discovery thereof.

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X. That the manufacture, use and sale of phonogram blanks employing and containing the said several inventions set forth in said several letters patent by the said defendants, and their preparation for and avowed determination to continue the same and their other aforesaid unlawful acts, in disregard and defiance of the rights of your orator, have the effect to and do encourage and induce others to venture to infringe the said several letters patent.

XI. Your orator therefore prays that the said defendants, Lambert Company and Thomas B. Lambert,



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individually and as an official of the said Lambert Company, and their officers, servants, agents, attorneys, employees, workmen and confederates, and each and every one of them, may be perpetually restrained and enjoined by the order and injunction of this Honorable Court from directly or indirectly making, constructing, using, vending, delivering, working or putting into operation or use, or in any wise counterfeiting or imitating, the said several inventions, or  
46 any phonogram blanks made or operated in accordance therewith or like or similar to those which the said defendants have heretofore made, sold, constructed, operated or used, and that the said defendants may be decreed to pay the costs of this suit, and that your orator may have such other and further relief as to this Honorable Court shall seem meet and as shall be agreeable to equity.

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XII. Your orator further prays that an injunction *pendente lite* be granted, issuing out of and under the seal of this Honorable Court, enjoining and restraining the said defendants and their officers, servants, agents, attorneys, employees, workmen and confederates, and each and every of them, to the same purport and tenor and effect as hereinbefore prayed for with regard to said perpetual injunction.

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XIII. And for as much as your orator can have no adequate relief save in this Court, to end therefore that the said defendants may, if they can, show why your orator should not have the relief hereby prayed and may, but not upon oath, an answer under oath being hereby expressly waived, according to their best and utmost knowledge, remembrance, information and belief, and according to the best and utmost knowledge, remembrance, information and belief, of the officers of the said defendant Lambert Company, full, true, direct and perfect answer make to the premises and to all the several matters hereinbefore stated and charged, as fully and particularly

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as if severally and separately interrogated as to each and every of said matters, and may be compelled to account for and pay to your orator the profits by them acquired and the damages suffered by your orator from the aforesaid unlawful acts, and that the Court may assess said profits and damages and may increase the damages to a sum not exceeding three times the amount thereof.

May it please your Honors to grant unto your orator the writ of subpoena issuing out of and under the seal of this Honorable Court, directed to the said defendants, Lambert Company and Thomas B. Lambert individually and as an official of the said Lambert Company, commanding them and each of them, by a certain day and under a certain penalty, to be and appear in this Honorable Court, then and there to answer to the premises and to stand to and abide such order and decree as may be made against them.

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And your orator will ever pray.

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EDISON PHONOGRAPH COMPANY,  
By THOMAS A. EDISON,

President.

ISHAM, LINCOLN & BEALE,  
Solicitors for Complainant.  
RICHARD N. DYER,  
Of Counsel for Complainant.

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STATE OF NEW JERSEY, } ss.:  
County of Essex,

THOMAS A. EDISON, being duly sworn, deposes and says that he is the president of Edison Phonograph Company, the complainant named in the foregoing bill of complaint; that he has read the said bill and knows the contents thereof; that the same is true to his own knowledge, save as to the matters therein stated to be

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alleged on information and belief, and as to those matters he believes it to be true; and that he verily believes himself to be the first, original and sole inventor of the improvements in phonograph blanks set forth in Letters Patent Nos. 382,418 and 382,462, referred to in the said bill of complaint.

THOMAS A. EDISON.

Subscribed and sworn to before me this 29th day of December, 1900.

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[SEAL.]

J. F. RANDOLPH,  
Notary Public for New Jersey.

CIRCUIT COURT OF THE UNITED STATES, NORTHERN DISTRICT OF ILLINOIS, NORTHERN DIVISION.

Edison Phonograph Company,	}
Complainant,	
vs.	
Lambert Company and Thomas	
B. Lambert,	}
Defendants.	

The joint and several answer of the Lambert Company and Thomas B. Lambert, defendants, to the bill of complaint of the Edison Phonograph Company, complainant.

These respondents, saving and reserving unto themselves all and all manner of benefit or advantage of exception that can or may be had or taken to the many errors, insufficiencies and inaccuracies in said bill of complaint contained, for answer thereunto, or to so much and such parts thereof as they are advised that it is material and necessary for them to make answer unto, answering say:

1. These respondents aver that they have no knowledge, save from said bill of complaint, that the said complainant is a corporation organized and existing under and by virtue of the laws of the State of New Jersey, but leaves the complainant to make such proof thereof as it may deem necessary.

2. These respondents admit that letters patent of the United States, Nos. 382,418 and 382,462, were issued to Thomas A. Edison the eighth day of May, A. D. 1888, for alleged new and useful Improvements in Phonogram



Blanks, as alleged in said bill of complaint; but these respondents do not admit that the said letters patent are good and valid in law, or that the said Thomas A. Edison was the original and first inventor of the pretended inventions or improvements described and claimed therein; or that the said pretended inventions or improvements were the product of any exercise of the inventive faculty or contained any patentable novelty whatever; or that the said pretended inventions or improvements were not in use or on sale for more than two years in this country before the application for said letters patent Nos. 382,418 and 382,462; or that the said complainant or its predecessor has invested and expended large sums of money in the manufacture and sale of phonogram blanks embodying and containing said alleged inventions or improvements; or that the said pretended inventions or improvements are capable of conjoint use, or have been so used by the complainant; or that the complainant and its predecessor has always marked their phonograms with the dates of said letters patent, respectively; or that the public has ever acquiesced in the validity of said letters patent, or either of them, as alleged in said bill; and these respondents call upon the complainant for strict proof as to such matters and each of them.

3. These respondents aver that they have no knowledge, save from said bill of complaint, that before the signing of this bill, or at any time, the said Thomas A. Edison, by an instrument in writing, signed by him and duly executed and recorded in the United States Patent Office, sold, assigned, transferred and set over to the said Edison Phonograph Company, its successors and assigns, all of the right, title and interest in and to said letters patent Nos. 382,418 and 382,462, and leaves the complainant to make such proof thereof as it may deem necessary.

*Answer.*

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4. These respondents deny that they have ever in any way, jointly or severally, made, used, or sold phonogram blanks embodying and containing the alleged inventions or improvements claimed in said letters patent Nos. 382,418 and 382,462, respectively, or that they have threatened or are threatening to make, use or sell phonogram blanks in violation and infringement of the exclusive rights of the complainant thereunder, or under either of them; but, on the contrary, these respondents aver and insist that all their operations in reference to the manufacture, sale, or use of phonogram blanks have been conducted in good faith, as a matter of right, and under letters patent of the United States granted to Thomas B. Lambert, Nos. 645,920 and 664,223, dated March 20 and December 18, 1900, respectively, and not in violation or infringement of any right of the complainant by reason of said letters patent, or otherwise.

5. These respondents admit that they are engaged—in a corporate capacity only—in the manufacture and sale of phonogram blanks at Chicago, in the County of Cook and State of Illinois, and that such articles are manufactured, used and sold by said company under two letters patent of the United States granted to Thomas B. Lambert—of which it is the assignee of the entire rights thereunder—the 20th day of March, A. D. 1900, and 18th day of December A. D. 1900, respectively, Nos. 645,920 and 664,223; that it has in good faith put the same upon the market and that said articles have met with great favor at the hands of the public and have proved very successful; and they charge that it is by reason of this fact and in **pursuance** of a scheme on the part of complainant to appropriate the inventions and business of these respondents that the said bill of complaint has been brought.



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*Answer.*

6. That as these respondents are informed and believe the pretended inventions and improvements described and claimed in said letters patent Nos. 382,418 and 382,462 are of no practical utility, importance or value and that the complainant has not for many years applied or used the same, but has been using the inventions of others, viz., the inventions of Chichester A. Bell and Sumner Tainter; and these respondents respectfully refer to the opinion of the Circuit Court of the United States for the District of New Jersey, delivered by his Honor Judge Acheson in *American Graphophone Co. v. Edison Phonograph Works*, reported in 68 Fed. Rep., p. 451, and following, and ask that the same be considered and treated as a part of their answer in this cause.

7. These respondents deny, on information and belief, that the subject matter described and claimed in said letters patent, Nos 382,418 and 382,462, respectively, amounts to a patentable combination as distinguished from a mere aggregation of parts, and aver and insist that, in view of the state of the arts at the date of the application for said patents, only mechanical skill as distinguished from invention was involved in the production thereof; wherefore these respondents submit that said letters patent are void for want of patentable subject matter, patentable novelty, and invention.

8. These respondents deny, on information and belief, that the said Thomas A. Edison was the original and first inventor or discoverer of the pretended inventions or improvements described and claimed in said letters patent, Nos. 382,418 and 382,462, or either of them; but, on the contrary, they aver and insist that the same pretended inventions and improvements, and each of them, were in public use long prior to the pretended invention thereof



*Answer.*

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by the said Thomas A. Edison, and particularly that the same were known and used at the following named places and by the following named persons, to-wit:

Thomas A. Edison, at Menlo Park, N. J., New York, N. Y., and elsewhere—present residence Llewellyn Park, N. J.

John F. Ott, at Menlo Park, N. J., Orange, N. J., New York, N. Y., and elsewhere—present residence Orange, N. J.

Edward H. Johnson, at Menlo Park, N. J., New York, N. Y., and elsewhere—present residence Greenwich, Conn.

Charles Bachelor, at Menlo Park, N. J., New York, N. Y., and elsewhere—present residence New York, N. Y.

John Kruesi, at Menlo Park, N. J., New York, N. Y., and elsewhere—present residence Schenectady, N. Y.

James U. McKenzie, at Menlo Park, N. J., New York, N. Y., and elsewhere—present residence Brooklyn, N. Y.

George H. Herrington, at Wichita, Kans., &c.—present residence Wichita, Kans.

Frank Lambert, at Ansonia, Conn., Brooklyn, Jamaica, and New York, N. Y.—present residence Brooklyn, N. Y.

Eugene Pastre, at Ansonia, Conn., and Jamaica, Brooklyn and New York, N. Y., and elsewhere—present residence Brooklyn, N. Y.

Walter D. Davis, at Ansonia, Conn., Jamaica, Brooklyn and New York, N. Y., and elsewhere—present residence Brooklyn, N. Y.

Isaac W. Heysinger, at Philadelphia, Pa., and elsewhere—present residence Philadelphia, Pa.

Ansonia Clock Company, at Ansonia, Conn., and elsewhere—present residence Ansonia, Conn.

Clarence J. Blake, at Boston, Mass., Washington, D. C., and elsewhere—present residence Boston, Mass.



C. S. Tainter, at Washington, D. C., and elsewhere—present residence Washington, D. C.

Clarence E. Gifford, at Jamestown, N. J., Chicago, Ills., Lewiston, and elsewhere—present residence Jamestown, N. J.

Sigmond Benjamin, at New York, N. Y., Menlo Park, N. J., and elsewhere—present residence New York, N. Y.

Theodore W. Searing, at New York, N. Y., and elsewhere—present residence New York, N. Y.

C. H. Field, at Providence, R. I., and elsewhere—present residence Providence, R. I.

O. H. Bogardus, at Syracuse, N. Y., and elsewhere—present residence Syracuse, N. Y.

Theodore Cooper, at Crompton Mills, Warwick and Providence, R. I., and elsewhere—present residence Syracuse, N. Y., Crompton Mills, Warwick, R. I.

Emile Berliner, at Washington, D. C., and elsewhere—present residence Washington, D. C.

T. Kennedy, at Mt. Carmel, Conn., and elsewhere—present residence Mt. Carmel, Conn.

Ralph H. Mershon, at Zanesville, Ohio, and elsewhere—present residence Zanesville, Ohio.

L. Hillman, at Newton, N. J., and elsewhere—present residence Newton, N. J.

Frederick B. Miles, at Philadelphia, Pa., and elsewhere—present residence Philadelphia, Pa.

James M. Connor, at Brooklyn, N. Y., and elsewhere—present residence Brooklyn, N. Y.

George M. Babbitt, at Providence, R. I., and elsewhere—present residence Providence, R. I.

John C. Guerrant, at Danville, Va., and elsewhere—present residence Danville, Va.

Robert R. Atchison, at Boston, Mass., and elsewhere—present residence Boston, Mass.

*Answer.*

7

Loring Pickering, at San Francisco, Cal., and elsewhere—present residence San Francisco, Cal.

A. Welford Hall, at New York, N. Y., and elsewhere—present residence New York, N. Y.

Thomas L. Luders, at Philadelphia, Pa., and elsewhere—present residence Philadelphia, Pa.

Milton Bradley, at Springfield, Mass., and elsewhere—present residence Springfield, Mass.

Robert M. Lockwood, at New York, N. Y., and elsewhere—present residence New York, N. Y.

William Leggo, at New York, N. Y., and elsewhere—present residence New York, N. Y.

A. S. Nichols, at New Haven, Conn., and elsewhere—present residence New Haven, Conn.

J. Harris Rogers, at Washington, D. C., and elsewhere—present residence Washington, D. C.

James Webb Rogers, at New York, N. Y., and elsewhere—present residence New York, N. Y.

Christopher C. Reynolds, at Prescott, Ariz., and elsewhere—present residence Prescott, Ariz.

John Absterdam, at New York, N. Y., and elsewhere—present residence New York, N. Y.

Rufus Anderson, at Peekskill, N. Y., and elsewhere—present residence Peekskill, N. Y.

George M. Guerrant, at New York, N. Y., Danville, Va., and elsewhere—present residence New York, N. Y.

Seth E. Beedy, at Farmington, Me., and elsewhere—present residence Farmington, Me.

John J. Linscott, at Farmington, Me., and elsewhere—present residence Farmington, Me.

Collett Leventhorpe, at Rutherfordton, N. C., Danville, N. J., and elsewhere—present residence Rutherfordton, N. J.



Samuel H. Bartlett at New York, N. Y., and elsewhere—present residence New York, N. Y.

The Molecular Telephone Company, at New York, N. Y., and elsewhere—present residence New York, N. Y.

John C. English, at New York, N. Y., and elsewhere—present residence New York, N. Y.

Henry J. Hagen, at Orange, N. J., and elsewhere—present residence Orange, N. J.

Walter Miller, at Orange, N. J., and elsewhere—present residence at Orange, N. J.

Chichester A. Bell, at Washington, D. C., and elsewhere—present residence Washington, D. C., and

Sumner Tainter, at Washington, D. C., and elsewhere—present residence Washington, D. C.

9. These respondents deny, on information and belief, that the said Thomas A. Edison was the original and first inventor or discover of the pretended inventions and improvements described and claimed in said letters patent, Nos. 382,418 and 382,462, or either of them; but, on the contrary, they aver and insist that said alleged inventions and improvements, and each of them, were described in various patents and publications long prior to the pretended invention and discovery thereof by the said Thomas A. Edison, and particularly in the following patents and publications, to-wit:

Thomas Blanchard, September 6, 1819;

William J. Casselman, 12,192, January 9, 1855;

C. H. Field, 17,146, April 28, 1857;

O. H. Bogardus, 32,959, July 30, 1861;

T. Kennedy, 52,294, January 30, 1866;

T. Cooper, 56,141, July 3, 1866;

R. S. Mershon, 72,521, December 24, 1867;

L. Hillman, 93,619, August 10, 1869;

## Answer.

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J. M. Connor, 115,934, June 13, 1871;  
 F. B. Miles, 111,859, February 14, 1871;  
 G. R. Babbitt, 153,212, July 21, 1874;  
 R. R. Atchison, 174,715, March 14, 1876;  
 J. C. Guerrant, 183,920, October 31, 1876;  
 L. Pickering, 191,464, May 29, 1877;  
 T. A. Edison, 200,521, February 19, 1878;  
 T. A. Edison, 201,760, March 26, 1878;  
 T. A. Edison, 213,554, March 25, 1879;  
 A. W. Hall, 219,939, September 23, 1879;  
 T. L. Luders, 222,292, December 2, 1879;  
 M. Bradley, 225,457, March 16, 1880;  
 T. A. Edison, 227,679, May 18, 1880;  
 R. M. Lockwood *et al.*, 231,065, August 10, 1880;  
 J. W. Kenyon, 232,978, October 5, 1880;  
 W. A. Laggo, 238,929, March 15, 1881;  
 S. E. Beedy, 266,746, October 31, 1882;  
 A. S. Nichols, 271,903, February 6, 1883;  
 J. H. Rogers, 277,349, May 8, 1883;  
 J. H. M. Waldorp, 279,292, June 12, 1883;  
 J. W. Rogers, 283,665, July 21, 1883;  
 C. C. Reynolds, 287,166, October 23, 1883;  
 J. Absterdam, 295,219, March 18, 1884;  
 R. Anderson, 296,376, April 8, 1884;  
 A. Schmid, 298,030, May 6, 1884;  
 G. M. Guerrant *et al.*, 305,178, September 16, 1884;  
 J. Houlehan, 335,522, February 2, 1886;  
 C. A. Bell, 336,203, February 16, 1886;  
 A. G. & C. A. Bell & S. Tainter, 341,212, May 4, 1886;  
 A. G. & C. A. Bell & S. Tainter, 341,213, May 4, 1886;  
 C. A. Bell & S. Tainter, 341,214, May 4, 1886;  
 S. Tainter, 341,287, May 4, 1886;  
 S. Tainter, 341,288, May 4, 1886;  
 L. Bock, Jr., 364,472, June 7, 1887;



E. Berliner, 372,786, November 8, 1887;  
 C. S. Tainter, 374,133, Novemebr 29, 1887;  
 C. S. Tainter, 375,579, December 27, 1887;  
 C. S. Tainter, 380,535, April 3, 1888;  
 T. A. Edison, 382,414, May 8, 1888;  
 T. A. Edison, 382,416, May 8, 1888;  
 T. A. Edison, 328,417, May 8, 1888;  
 T. A. Edison, 328,418, May 8, 1888;  
 T. A. Edison, 382,419, May 8, 1888;  
 C. S. Tainter, 385,886, July 10, 1888;  
 C. S. Tainter, 385,887, July 10, 1888;  
 T. A. Edison, 386,974, July 31, 1888;  
 G. H. Herrington, 392,953, November 13, 1888;  
 C. S. Tainter, 393,130, November 20, 1888;  
 F. L. Douglas, 475,490, May 24, 1892.

## BRITISH LETTERS PATENT.

William Mann, 1912 of 1857;  
 Aimee L. E. Brittmayer, 324 of 1860;  
 Henry B. Greenwood, 225 of 1870;  
 Thomas A. Edison, 2909 of 1877;  
 Thomas A. Edison 1644 of 1878; and  
 H. J. Hadden, 291 of 1882.

## FRENCH LETTERS PATENT.

T. A. Edison, 121,687, February 19, 1878;  
 Addition, February 19, 1878;  
 T. A. Edison, 124,974, September 17, 1878;  
 Charles Cros, 124,213, July 27, 1878;  
 Addition, October 3, 1878;  
 Antonio Vicini, 128,215, October 17, 1879;  
 Charles Weyher, 135,688, May 20, 1880;  
 Addition, May 23, 1880;  
 Addition, June 11, 1880;

*Answer.*

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Addition, September 20, 1883;  
 Paul Goloubitzky, 145,584, December 7, 1881;  
 Addition, March 15, 1882;  
 Addition, September 26, 1882;  
 Addition, September 20, 1883;  
 Morel, 146,670, March 17, 1883;  
 Morel, 146,673, March 17, 1883; and  
 Claude A. Terrier, 156,749, November 8, 1883.

## GERMAN LETTERS PATENT.

T. A. Edison, 12,631, July 12, 1878;  
 Kleist & Co., 11,053, January 24, 1879;  
 T. A. Edison, 14,308, August 18, 1881; and  
 T. A. Edison, 12,631, April 27, 1881.

## CANADIAN LETTERS PATENT.

T. A. Edison, 8,026, October 17, 1877;  
 Issued, October 20, 1877; and  
 T. A. Edison, 9,282, October 19, 1878.

## PATENTS GRANTED TO THOMAS A. EDISON.

Belgium, 43,984, January 31, 1878;  
 Belgium, 45,375, June 29, 1878;  
 Italy, 422, February 8, 1878;  
 Italy, July 4, 1878;  
 Austria, January 1, 1879;  
 Austria, January 8, 1879;  
 Russia, 1161, February 15, 27, 1882;  
 Norway, October 8, 1878;  
 Sweden, March 29, 1879;  
 Denmark, 1345, October 31, 1878;  
 India, March 20, 1879;  
 New South Wales, September 16, 1878;  
 Victoria, August 13, 1878;  
 Victoria, 2549, August 15, 1878.



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*Answer.*

Without this, that any other matter, cause or thing in said bill of complaint contained and not here and hereby well and sufficiently answered unto, confessed and avoided, traversed or denied, is true; all which matters and things these respondents are ready and willing to aver, maintain and prove as this honorable court shall direct, and pray to be hence dismissed with their reasonable costs and charges in this behalf most wrongfully sustained.

And these respondents will ever pray, etc.

LAMBERT COMPANY,  
THOMAS B. LAMBERT,  
By THOS. F. SHERIDAN,  
*Their Solicitor.*

*Answer.*

13

CIRCUIT COURT OF THE UNITED STATES, NORTHERN DISTRICT OF ILLINOIS, NORTHERN DIVISION.

National Phonograph Company,	} In Equity.
<i>Complainant,</i>	
<i>vs.</i>	
Lambert Company and Thomas	
B. Lambert,	} In Equity.
<i>Defendants.</i>	

The joint and several answer of the Lambert Company and Thomas B. Lambert, defendants, to the bill of complaint of the National Phonograph Company, complainant.

These respondents, now and at all times hereafter saving and reserving unto themselves all and all manner of benefit or advantage of exception that can or may be had or taken to the many errors, insufficiencies and inaccuracies in said bill of complaint contained, for answer thereunto, or to so much and such parts thereof as they are advised that it is material and necessary for them to make answer unto, answering say:

1. These respondents aver that they have no knowledge, save from said bill of complaint, that the said complainant is a corporation organized and existing under and by virtue of the laws of the State of New Jersey, but leaves the complainant to make such proof thereof as it may deem necessary.

2. These respondents admit that letters patent of the United States, No. 414,761, were issued to Thomas A. Edison, the 12th day of November A. D. 1889, for alleged new and useful Improvements in Phonogram Blanks, as alleged in said bill of complaint; but these respondents do



not admit that the said letters patent are good and valid in law; or that the said Thomas A. Edison was the original and first inventor of the pretended inventions or improvements described and claimed therein; or that the said pretended inventions or improvements were the product of any exercise of the inventive faculty or contained any patentable novelty whatever; or that the said pretended inventions or improvements were not in use or on sale for more than two years in this country before the application for said letters patent No. 414,761; or that the said complainant or its predecessor has invested and expended large sums of money in the manufacture and sale of phonogram blanks embodying and containing said alleged inventions or improvements; or that the complainant and its predecessor has always marked their phonograms with the dates of said letters patent, respectively; or that the public has ever acquiesced in the validity of said letters patent, or either of them, as alleged in said bill; but these respondents call upon the complainant for strict proof as to such matters and each of them.

3. These respondents aver that they have no knowledge, save from said bill of complaint, that before the signing of this bill, or at any time, the said Thomas A. Edison, by an instrument writing, signed by him and duly executed and recorded in the United States Patent Office, sold, assigned, transferred and set over to the said National Phonograph Company, its successors and assigns, all of the right, title and interest in and to said letters patent No. 414,761, and leaves the complainant to make such proof thereof as it may deem necessary.

4. These respondents deny that they have ever in any way, jointly or severally, made, used or sold phonogram blanks embodying and containing the alleged inventions

*Answer.*

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or improvements claimed in said letters patent No. 414,761, or that they have threatened or are threatening to make, use or sell phonogram blanks in violation and infringement of the exclusive rights of the complainant thereunder; but, on the contrary, these respondents aver and insist that all their operations in reference to the manufacture, sale, or use of phonogram blanks have been conducted in good faith, as a matter of right, and under letters patent of the United States granted to Thomas B. Lambert, Nos. 645,920 and 664,223, dated March 20 and December 18, 1900, respectively, and not in violation or infringement of any rights of the complainant by reason of said letters patent, or otherwise.

5. These respondents admit that they are engaged—in a corporate capacity only—in the manufacture and sale of phonogram blanks at Chicago, in the County of Cook and State of Illinois, and that such articles are manufactured, used and sold by said company under two letters patent of the United States granted to Thomas B. Lambert—of which it is the assignee of the entire rights thereunder—the 20th day of March, and 18th day of December, A. D. 1900, Nos. 645,920 and 664,223, respectively; that it has in good faith put the same upon the market and that said articles have met with great favor at the hands of the public and have proved very successful; and they charge that it is by reason of this fact and in pursuance of a scheme on the part of the complainant to appropriate the inventions and business of these respondents that the said bill of complaint has been brought.

6. That as these respondents are informed and believe the pretended inventions and improvements described and claimed in said letters patent No. 414,761 are of no practical utility, importance or value, and that the complainant



has not for many years applied or used the same, but has been using the inventions of others, viz., the inventions of Chichester A. Bell and Sumner Tainter; and these respondents respectfully refer to the opinion of the Circuit Court of the United States for the District of New Jersey, delivered by his Honor, Judge Acheson, in *American Graphophone Company v. Edison Phonograph Works*, reported in 68 Fed. Rep., p. 451 and following, and ask that the same be considered and treated as a part of their answer in this cause.

7. These respondents deny, on information and belief, that the subject matter described and claimed in said letters patent No. 414,761 amounts to a patentable combination as distinguished from a mere aggregation of parts, and aver and insist that, in view of the state of the arts at the date of the application for said patents, only mechanical skill as distinguished from invention was involved in the production thereof; wherefore these respondents submit that said letters patent are void for want of patentable subject matter, patentable novelty, and invention.

8. These respondents deny, on information and belief, that the said Thomas A. Edison was the original and first inventor or discoverer of the pretended inventions or improvements described and claimed in said letters patent No. 414,761; but, on the contrary, they aver and insist that the same pretended inventions and improvements, and each of them, were in public use long prior to the pretended invention thereof by the said Thomas A. Edison, and particularly that the same were known and used at the following named places and by the following named persons, to-wit:

Thomas A. Edison, at Menlo Park, N. J., New York, N. Y., and elsewhere—present residence Llewellyn Park, N. J.

*Answer.*

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John F. Ott, at Menlo Park, N. J., Orange, N. J., New York, N. Y., and elsewhere—present residence Orange, N. J.

Edward H. Johnson, at Menlo Park, N. J., New York, N. Y., and elsewhere—present residence Greenwich, Conn.

Charles Bachelor, at Menlo Park, N. J., New York, N. Y., and elsewhere—present residence New York, N. Y.

John Kruesi, at Menlo Park, N. J., New York, N. Y., and elsewhere—present residence Schenectady, N. Y.

James U. McKenzie, at Menlo Park, N. J., New York, N. Y., and elsewhere—present residence Brooklyn, N. Y.

George H. Herrington, at Wichita, Kans., &c.—present residence Wichita, Kans.

Frank Lambert, at Ansonia, Conn., Brooklyn, Jamaica, and New York, N. Y.—present residence Brooklyn, N. Y.

Eugene Pastre, at Ansonia, Conn., and Jamaica, Brooklyn and New York, N. Y., and elsewhere—present residence Brooklyn, N. Y.

Walter D. Davis, at Ansonia, Conn., Jamaica, Brooklyn and New York, N. Y., and elsewhere—present residence Brooklyn, N. Y.

Isaac W. Heysinger, at Philadelphia, Pa., and elsewhere—present residence Philadelphia, Pa.

Ansonia Clock Company, at Ansonia, Conn., and elsewhere—present residence Ansonia, Conn.

Clarence J. Blake, at Boston, Mass., Washington, D. C., and elsewhere—present residence Boston, Mass.

C. S. Tainter, at Washington, D. C., and elsewhere—present residence Washington, D. C.

Clarence E. Gifford, at Jamestown, N. J., Chicago, Ills., Lewiston, and elsewhere—present residence Jamestown, N. J.

Sigmond Benjamin, at New York, N. Y., Menlo Park, N. J., and elsewhere—present residence New York, N. Y.



Theodore W. Searing, at New York, N. Y., and elsewhere—present residence New York, N. Y.

C. H. Field, at Providence, R. I., and elsewhere—present residence Providence, R. I.

O. H. Bogardus, at Syracuse, N. Y., and elsewhere—present residence Syracuse, N. Y.

Theodore Cooper, at Crompton Mills, Warwick and Providence, R. I., and elsewhere—present residence Syracuse, N. Y., Crompton Mills, Warwick, R. I.

Emile Berliner, at Washington, D. C., and elsewhere—present residence Washington, D. C.

T. Kennedy, at Mt. Carmel, Conn., and elsewhere—present residence Mt. Carmel, Conn.

Ralph H. Mershon, at Zanesville, Ohio, and elsewhere—present residence Zanesville, Ohio.

L. Hillman, at Newton, N. J., and elsewhere—present residence Newton, N. J.

Frederick B. Miles, at Philadelphia, Pa., and elsewhere—present residence Philadelphia, Pa.

James M. Connor, at Brooklyn, N. Y., and elsewhere—present residence Brooklyn, N. Y.

George M. Babbitt, at Providence, R. I., and elsewhere—present residence Providence, R. I.

John C. Guerrant, at Danville, Va., and elsewhere—present residence Danville, Va.

Robert R. Atchison, at Boston, Mass., and elsewhere—present residence Boston, Mass.

Loring Pickering, at San Francisco, Cal., and elsewhere—present residence San Francisco, Cal.

A. Welford Hall, at New York, N. Y., and elsewhere—present residence New York, N. Y.

Thomas L. Luders, at Philadelphia, Pa., and elsewhere—present residence Philadelphia, Pa.

*Answer.*

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Milton Bradley, at Springfield, Mass., and elsewhere—  
present residence Springfield, Mass.

Robert M. Lockwood, at New York, N. Y., and elsewhere—present residence New York, N. Y.

William Leggo, at New York, N. Y., and elsewhere—  
present residence New York, N. Y.

A. S. Nichols, at New Haven, Conn., and elsewhere—  
present residence New Haven, Conn.

J. Harris Rogers, at Washington, D. C., and elsewhere—  
present residence Washington, D. C.

James Webb Rogers, at New York, N. Y., and elsewhere—present residence New York, N. Y.

Christopher C. Reynolds, at Prescott, Ariz., and elsewhere—present residence Prescott, Ariz.

John Absterdam, at New York, N. Y., and elsewhere—  
present residence New York, N. Y.

Rufus Anderson, at Peekskill, N. Y., and elsewhere—  
present residence Peekskill, N. Y.

George M. Guerrant, at New York, N. Y., Danville, Va., and elsewhere—present residence New York, N. Y.

Seth E. Beedy, at Farmington, Me., and elsewhere—  
present residence Farmington, Me.

John J. Linscott, at Farmington, Me., and elsewhere—  
present residence Farmington, Me.

Collett Leventhorpe, at Rutherfordton, N. C., Danville, N. J., and elsewhere—present residence Rutherfordton, N. J.

Samuel H. Bartlett, at New York, N. Y., and elsewhere—  
present residence, New York, N. Y.

The Molecular Telephone Company, at New York, N. Y., and elsewhere—present residence New York, N. Y.

John C. English, at New York, N. Y., and elsewhere—  
present residence New York, N. Y.



Henry J. Hagen, at Orange, N. J., and elsewhere—present residence Orange, N. J.

Walter Miller, at Orange, N. J., and elsewhere—present residence at Orange, N. J.

Chichester A. Bell, at Washington, D. C., and elsewhere—present residence Washington, D. C., and

Sumner Tainter, at Washington, D. C., and elsewhere—present residence Washington, D. C.

9. These respondents deny, on information and belief, that the said Thomas A. Edison was the original and first inventor or discover of the pretended inventions and improvements described and claimed in said letters patent, No. 414,761, but on the contrary, they aver and insist that said alleged inventions and improvements, and each of them, were described in various patents and publications long prior to the pretended invention and discovery thereof by the said Thomas A. Edison, and particularly in the following patents and publications, to-wit:

Thomas Blanchard, September 6, 1819;

William J. Casselman, 12,192, January 9, 1855;

C. H. Field, 17,146, April 28, 1857;

O. H. Bogardus, 32,959, July 30, 1861;

T. Kennedy, 52,294, January 30, 1866;

T. Cooper, 56,141, July 3, 1866;

R. S. Mershon, 72,521, December 24, 1867;

L. Hillman, 93,619, August 10, 1869;

J. M. Connor, 115,934, June 13, 1871;

F. B. Miles, 111,859, February 14, 1871;

G. R. Babbitt, 153,212, July 21, 1874;

R. R. Atchison, 174,715, March 14, 1876;

J. C. Guerrant, 183,920, October 31, 1876;

L. Pickering, 191,464, May 29, 1877;

T. A. Edison, 200,521, February 19, 1878;

*Answer.*

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- T. A. Edison, 201,760, March 26, 1878;  
 T. A. Edison, 213,554, March 25, 1879;  
 A. W. Hall, 219,939, September 23, 1879;  
 T. L. Luders, 222,292, December 2, 1879;  
 M. Bradley, 225,457, March 16, 1880;  
 T. A. Edison, 227,679, May 18, 1880;  
 R. M. Lockwood *et al.*, 231,065, August 10, 1880;  
 J. W. Kenyon, 232,978, October 5, 1880;  
 W. A. Leggo, 238,929, March 15, 1881;  
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 A. S. Nichols, 271,903, February 6, 1883;  
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 J. W. Rogers, 283,665, July 21, 1883;  
 C. C. Reynolds, 287,166, October 23, 1883;  
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 R. Anderson, 296,376, April 8, 1884;  
 A. Schmid, 298,030, May 6, 1884;  
 G. M. Guerrant *et al.*, 305,178, September 16, 1884;  
 J. Houlehan, 335,522, February 2, 1886;  
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Aimee L. E. Brittmayer, 324 of 1860;  
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*Answer.*

23

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 India, March 20, 1879;  
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 Victoria, August 13, 1878;  
 Victoria, 2549, August 15, 1878.

Without this, that any other matter, cause or thing in  
 said bill of complaint contained and not here and hereby  
 well and sufficiently answered unto, confessed and avoided,  
 traversed or denied, is true; all which matters and things  
 these respondents are ready and willing to aver, maintain  
 and prove as this honorable court shall direct, and pray to



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*Stipulation.*

be here dismissed with their reasonable costs and charges  
in this behalf most wrongfully sustained.

And these respondents will ever pray, etc.

LAMBERT COMPANY,  
THOMAS B. LAMBERT,  
By THOS. F. SHERIDAN,  
*Their Solicitor.*

CIRCUIT COURT OF THE UNITED STATES, NORTHERN DIS-  
TRICT OF ILLINOIS, NORTHERN DIVISION.

National Phonograph Company  
*vs.*  
Lambert Company and Thomas B. Lambert, } In Equity.

Edison Phonograph Company  
*vs.*  
Lambert Company and Thomas B. Lambert, } In Equity.

It is hereby stipulated by and between the counsel for  
the respective parties to the above entitled causes that  
printed copies of the records may be used for all purposes  
in lieu of the original type-written testimony and paper  
exhibits, and with the same force and effect.

RICHARD N. DYER,  
*For Complainants.*  
THOMAS F. SHERIDAN,  
*Solicitor for Defendants.*

November 8, 1902.





## UNITED STATES CIRCUIT COURT,

NORTHERN DISTRICT OF ILLINOIS—NORTHERN DIVISION.

55

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NATIONAL PHONOGRAPH COMPANY,  
Complainant,

vs.

LAMBERT COMPANY and THOMAS B.  
LAMBERT,

56

Defendants.

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In Equity.

THOMAS F. SHERIDAN, Esq.,

Solicitor for Defendants,

Marquette Building, Chicago, Illinois:

Please take notice that the complainant herein will take the testimony of Frank L. Dyer, of Montclair, in the State of New Jersey, and others, each and all of whom reside more than one hundred (100) miles from the place of trial herein, and more than one hundred

Notice.

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(100) miles from any place at which a Circuit Court of the United States for the Northern District of Illinois, Northern Division, is appointed to be held by law, at final hearing for use on behalf of the complainant, before John R. Taylor, Esq., a notary public in and for the County of Kings with certificate filed in New York County, who is not of counsel or interested in this cause, at the office of Dyer, Edmonds & Dyer, No. 31 Nassau street, in the City and State of New York, on the 21st day of January, 1902, at 11 o'clock A. M., and thereafter from day to day as the taking of the depositions may be adjourned; and such testimony will be so taken in accordance with the provisions of Sections 863, 864 and 865 of the Revised Statutes of the United States, and the equity rules.

58

Dated January 10, 1902.

ISHAM, LINCOLN & BEALE,  
Solicitors for Complainant.

Due and timely service of the above notice is hereby  
admitted this 10th day of January, 1902.

59

THOMAS F. SHERIDAN,  
Solicitor for Defendants.

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UNITED STATES CIRCUIT COURT,  
NORTHERN DISTRICT OF ILLINOIS,  
NORTHERN DIVISION.

62

EDISON PHONOGRAPH COMPANY,  
Complainant,

vs.

LAMBERT COMPANY and THOMAS B.  
LAMBERT,  
Defendants.

In Equity.

63

THOMAS F. SHERIDAN, Esq.,  
Solicitor for Defendants,  
Marquette Building,  
Chicago, Illinois :

64

Please take notice that the complainant herein will take the testimony of Frank L. Dyer, of Montclair, in the State of New Jersey, and others, each and all of whom reside more than one hundred (100) miles from the place of trial herein, and more than one hundred (100) miles from any place at which a Circuit Court of the United States, for the Northern District of Illinois, Northern Division, is appointed to be held by law, at final hearing for use on behalf of complainant, before John R. Taylor, Esq., a Notary Public in and for the County of Kings, with certificate filed in New York County, who is not of counsel nor interested in this cause, at the office of Dyer, Edmonds & Dyer, No. 31 Nassau street, in the City and State of New York, on the 21st day of January, 1902, at 11 o'clock A. M., and thereafter from day to day as the taking of the depositions may be adjourned; and such testimony

Stipulation.

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will be so taken in accordance with the provisions of Sections 863, 864 and 865 of the Revised Statutes of the United States, and the equity rules.

Dated January 10, 1902.

ISHAM, LINCOLN & BEALE,  
Solicitors for Complainant.

Due and timely service of the above notice is hereby admitted this 10th day of January, 1902.

THOMAS F. SHERIDAN,  
Solicitor for Defendants.

66

UNITED STATES CIRCUIT COURT,  
NORTHERN DISTRICT OF ILLINOIS.

EDISON PHONOGRAPH COMPANY,  
Complainant,

vs.

LAMBERT COMPANY and THOMAS B.  
LAMBERT,  
Defendants.

In Equity.

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NATIONAL PHONOGRAPH COMPANY,  
Complainant,

vs.

LAMBERT COMPANY and THOMAS B.  
LAMBERT,  
Defendants.

In Equity.

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Testimony for complainants taken before JOHN R. TAYLOR, Esq., Notary Public and Special Examiner, by consent, at No. 31 Nassau street, in the City and State of New York.



JANUARY 21, 1902.

Met pursuant to notice.

Present—RICHARD N. DYER, Esq., for complainants;  
THOMAS F. SHERIDAN, Esq., for defendants.

It is stipulated that testimony may be taken by either complainants or defendants in both cases jointly and simultaneously.

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To simplify the record and reduce cost of printing, defendants' counsel admits the incorporation of the complainant companies, the grant of the patents in suit and the title thereto in the complainants, as set forth in the bills of complaint, subject to correction if errors should appear; and further consents that the complainants may put in evidence, in place of certified copies of the patents in suit, regular printed Patent Office copies of the drawings and specifications of such patents.

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Complainants' counsel, in accordance with this stipulation, offers in evidence regular printed Patent Office copies of the three patents in suit, and the same are marked "Complainants' Exhibit Patent in Suit No. 382,418," "Complainants' Exhibit Patent in Suit No. 382,462" and "Complainants' Exhibit Patent in Suit No. 414,761."

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FRANK L. DYER, being duly sworn in both cases, deposes and says as follows:

DIRECT EXAMINATION BY MR. DYER:

1 Q. What is your name, age, residence and occupation?

A. Frank L. Dyer; age, 31; Montclair, New Jersey; patent lawyer, solicitor and expert.

2 Q. Please state what your experience has been in connection with talking machines, and particularly with reference to the patents thereon, giving also your general experience as a patent expert?

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A. In 1886, after passing through the public schools of Washington, D. C., I determined to study patent law and for this purpose entered the office of my father, Colonel George W. Dyer, who during his lifetime was a prominent patent lawyer. I studied law at the Columbian Law School, at Washington, and was also a student at the Corcoran Scientific School, of that city, devoting my attention almost exclusively to matters connected with physics and chemistry. On the death of my father, in 1889, I succeeded to his business, which I carried on continuously at Washington until 1897, when I removed to New York.

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During my business life I have had occasion to make several thousand examinations through many and diverse classes of invention, in order to determine the probable patentability of devices submitted to me for that purpose, and have also prepared and prosecuted applications for more than a thousand patents; so that I have become familiar with the condition of the art in reference to many lines of industrial work. In addition to this, I have frequently had occasion to examine and consider patents with a view of expressing opinions concerning their validity and scope, as well as to compare patents with mechanical structures for the purpose of expressing opinions on the question of infringement. I have had occasion, in a considerable number of instances, also to testify as expert in suits based on patents. Since coming to New York in 1897 I have had entire charge of Mr. Edison's patent soliciting work, have frequently consulted with him regarding his inventions, and have prepared and prosecuted in the Patent Office all of his applications for patents. I have made a number of inventions myself in different arts, some of which have been adopted commercially, and, up to the present time, have filed about fifty applications for patents thereon. I am an associate of the American Institute of Mechanical Engineers.

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In 1887 I had occasion to examine one of the very earliest graphophones made by the American Grapho-



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phone Company ; about 1888 I had occasion to examine one of the early Edison commercial phonographs, for the purpose of securing records from members of the Korean Legation at Washington ; through the courtesy of Professor Emile Berliner, I was given the opportunity of examining the first gramophone during its experimental stage, as early as 1889 or 1890 ; and since that time, and particularly during the last five years, I have given very close study to talking machines and to the patents bearing thereon.

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3 Q. Have you examined, and do you understand, patents to Thomas A. Edison, No. 382,419, dated May 8, 1888, No. 382,462, dated May 8, 1888, and No. 414,761, dated November 12, 1889, all for phonogram blanks ?

A. I have examined the patents to which you have referred, and believe I understand same.

4 Q. I hand you a phonograph record, and ask if you know what it represents ?

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A. The record to which you refer is a duplicate celluloid phonographic record which I understand is made by the defendants herein, and is an article that I am entirely familiar with.

The record in question is introduced in evidence and marked "Complainants' Exhibit Defendants' Record."

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5 Q. Please compare the exhibit record with the Edison patent No. 382,418 involved herein, and state whether or not the said record embodies the invention described and illustrated in said patent and covered by the first and second claims thereof ?

A. The patent to which you refer, as well as the other patents to which you have before called my attention, relates to an art which not only found its inception with Mr. Edison, but the commercial development of which was due largely to his genius, namely the art of recording and reproducing sounds, including articulate speech and music. The three patents which

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I have had occasion to consider, including the one to which your present question is particularly limited, relate to that part of the phonograph called the "record" or "phonogram," and which before being subjected to the action of the recording devices is called the "phonograph blank" or "phonogram blank." These records or blanks are removable cylinders made of smooth, amorphous material, receiving or adapted to receive the very delicate impressions of the recording devices, and which are adapted to be used over and over again for reproducing the sounds as often as they may be desired. The records or blanks are separate commercial articles of manufacture, and are all of standard size, capable of use interchangeably on different forms of talking machines, such as the phonograph or graphophone, for example.

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Referring now to patent No. 382,418, Mr. Edison states that the object of the invention thereof—

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"is to produce a cylindrical phonogram blank or phonogram which can be readily placed upon the phonogram cylinder of a phonograph and will centre itself, and will also be adapted to retain its place upon the phonogram cylinder by friction alone."

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These objects are accomplished by making the cylinder or mandrel of the phonograph with a slight taper and by similarly tapering the bore of the record or blank, so that by sliding the latter over the mandril or phonograph cylinder it will automatically center itself so as to be truly concentric to the mandril, and will also retain its position so as to be rotated with respect to the recording and reproducing devices by friction alone. This simple expedient of tapering the bore of the record or blank while retaining the cylindrical form for its recording surface, and of properly modifying the phonograph or other talking machine so that it will be provided with a tapered mandrel for receiving the record or blank, secured all the objects which Mr. Edison sought to



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secure by this invention. That invention made it possible to readily place the record or blank on the mandrel or phonogram cylinder of the phonograph, for the reason that all that it is necessary to do is to push the record or blank over the mandrel until the former binds on the latter and retains its place by friction. The invention effected the true centering of the record or blank with respect to the recording or reproducing devices, for the reason that when the record or blank is in engagement with the mandrel the two will be absolutely concentric, and since the relation between the mandrel of the phonograph and its recording and reproducing devices is fixed, the record or blank when in position on the mandrel will for all portions of its surface occupy the desired relation to those devices. Finally, the invention made it possible for the record or blank to retain its position on the mandrel or phonogram cylinder by friction alone, for the reason that the tapered bore permits the record or blank to be tightly engaged with the mandrel merely by forcing the former longitudinally until it binds in place. Thus by a very simple expedient very important practical advantages were secured, which have, so far as I know, been utilized in all modern talking machines employing cylindrical records.

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A further and very important advantage arising from the invention of the patent under consideration is that phonograph records or blanks of widely different lengths can be properly received and held upon the tapered mandrel, for the reason that the engagement between the record or blank and the mandrel is a radial and not a longitudinal engagement, as was the case, for example, with the earliest graphophones, wherein the records were supported between two end disks, one of which was spring-pressed. In order to illustrate this capacity of the invention, Edison in the patent in question shows in figure 2 four blanks, the shortest of which is only one-fourth the length of the longest, and all of which are adapted to be properly

F. L. Dyer.

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supported on the mandrel by reason of their tapered form.

The two claims to which you direct my attention are as follows:

"1. A phonogram blank or phonogram having a bore tapered throughout its length, substantially as set forth.

"2. A phonogram blank or phonogram having a cylindrical recording surface and a tapering bore, substantially as set forth." 90

The language of these claims is clear, and there can be, I think, no misinterpretation of their exact meaning. The first claim covers broadly any phonograph record or blank with a tapered bore adapted to be received upon a tapered mandrel and having either a cylindrical recording surface or some other curved recording surface—for instance, one slightly tapered. At the present time all commercial talking-machine records and blanks of this type are provided with cylindrical recording surfaces and with tapered bores, so that the thickness of the wall of the blank is greater at one end than at the other, as shown in figure 1 of the patent in question. Yet the first claim is broad enough, for example, to cover a blank the walls of which are of the same thickness throughout, in which case the recording surface would be formed with the same taper as the bore, and that claim is broad enough to also include other constructions of blanks or records which would be perfectly operative. Since defendants' records are provided with cylindrical recording surfaces, it is not necessary for us to speculate as to what the claim might cover, because it could be limited, if necessary, to a record or blank with the particular form of recording surface, namely, a cylindrical one, which the patent describes, and it still would apply exactly to the construction of records manufactured and sold by defendants herein. The second claim is distinguished from the first in being specifically limited to a cylindrical recording surface and a tapered bore. 91 92



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The records made by defendants (Complainants' Exhibit Defendants' Record) are separate sound records adapted to be used with standard talking machines, such as phonographs and graphophones. They can, in fact, be used interchangeably with phonograph and graphophone records. These defendants' records are made of celluloid, which is sufficiently hard and smooth for the purpose, and they are formed with a cylindrical recording surface into which the sound record is im-

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pressed, and their bores are tapering so as to be received by a tapered mandrel. In fact, defendants' records are formed with the exact taper that other standard records have, since they are adapted to be received on the same mandrels which standard phonograph and graphophone records have been designed to engage. The only superficial distinction between defendants' records and the record or blank of the patent in question is, that with the former a part of the bore is cut away, so that the surface of the bore which

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engages the mandrel is reduced. Since it is only necessary to engage the record or blank with the mandrel with sufficient friction to cause the record to turn with respect to the recording and reproducing devices, it is evident that the area of the tapered bore which engages the mandrel can be reduced until only sufficient surface is left to provide for the necessary friction. This removal of superfluous material in the bore of the record possesses advantages which are clearly recognized by Mr. Edison in his patent No.

96

414,761, which I understand I am presently to consider, but for the purposes of the present patent it is unnecessary for me to take this fact into consideration in comparing defendants' records with the claims, it being sufficient to say that the bore of the latter records is tapered precisely as the patent in question recites and for the accomplishment of the same purposes and objects which that patent sets forth. In other words, with defendants' records, they are placed on the phonograph cylinder with the same readiness as the records of the patent in question, they automatically



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center themselves, and they retain their position by friction alone.

I find, therefore, in defendants' records all the features of the first and second claims of Edison patent No. 382,418, and in my opinion defendants records are the equivalent of the articles of manufacture embraced therein.

6 Q. Please compare Complainants' Exhibit Defendants' Record with the Edison patent No. 382,462 involved herein, and state whether or not the said record embodies the invention described and illustrated in said patent and covered by the claims thereof? 98

A. The patent in question has for its object the overcoming of an objection which had been formerly encountered with composition records or blanks made by coating a suitable backing with wax or wax-like recording surface. These composite records or blanks were used with the first graphophones, and one is shown, for example, in Edison patent No. 382,418, which I have before considered. The difficulty with these composite records was, that owing to the different coefficient of expansion of the backing and recording surface, the latter, under the effect of heat, would tend to separate from the backing, and under the effect of cold, to contract so much more rapidly than the backing as to become cracked and injured. It must be manifest that any record made by coating a backing with a waxlike recording surface would be open to these objections unless the backing and recording surface possessed the same coefficient of expansion and contraction, so that the record as a whole would expand and contract similarly throughout its mass. When it is remembered that with a phonographic record we are dealing with indentations having extremely minute dimensions, the fact will be appreciated that anything that produces cracks, wrinkles, or other distortions in the recording surface is highly objectionable, and these objections up to the time of the present patent were necessarily present with the composite records used prior thereto. What Edison 99 100



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did, therefore, in the present patent was to make the record with the same coefficient of expansion throughout its mass by constructing the record or blank of the same material throughout or by forming it of different materials having the same coefficient of expansion. The patent, in fact, says that the invention can be carried out in either way "so long as the whole has substantially the same coefficient expansion." The particular record or blank which the patent

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in question specifically describes is one having a cylindrical recording surface and a tapered bore; so that so far as this record is concerned, the invention of the present patent may be broadly stated to be the making of the record of Edison patent No. 382,418 of the same material or of different materials having the same coefficient of expansion throughout the entire mass.

The claims of the patent under consideration are as follows :

103

" 1. A phonogram blank or phonogram constructed wholly of wax or waxlike materials and having the same coefficient of expansion throughout its mass, substantially as set forth.

" 2. A phonogram blank or phonogram constructed as a hollow cylinder wholly of wax or waxlike materials and having the same coefficient of expansion throughout its mass, substantially as set forth.

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" 3. A phonogram blank or phonogram constructed as a hollow cylinder with a tapering bore wholly of wax or waxlike materials and having the same coefficient of expansion throughout its mass, substantially as set forth."

The first claim is obviously broad enough to include not only a cylindrical phonographic record, but also a flat or disklike record such as is used, for example, in the commercial gramophone and other machines of that type. The second claim, although limited to a cylindrical phonograph record or blank, is broad

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enough to include one having also a cylindrical bore, as was the case with the earliest graphophone records. The third claim is specifically restricted to a cylindrical record or blank with a tapering bore of the type covered for the first time in Edison patent No. 382,418 before considered. The feature of novelty of each of the claims is defined by the statement that the record or blank, whatever its form may be, is always constructed "wholly of wax or waxlike materials and having the same coefficient of expansion throughout its mass."

106

Defendants' records are made entirely of celluloid throughout, so that said records have the same coefficient of expansion throughout their mass. Those records, as I have before said, are formed with cylindrical recording surfaces and with tapered bores, in these respects conforming to the terms of the third claim of the patent in question, as well, of course, as to the terms of the first and second claims of that patent, which are more generic than the third claim. Celluloid, for the purpose of a phonographic record or blank, is a wax-like material, because it possesses the desirable qualities of hardness, smoothness and uniformity due to its amorphous character, that any other approved recording material must have. At the present time all phonograph and graphophone records are made of a very hard, insoluble soap, to which is added a small proportion of wax, and these latter records are chemically distinguished from wax records, although they are physically wax-like in character. As a material for making a phonograph record celluloid is just as wax-like in character as is the hard, insoluble soap of which other talking-machine records are now and have been made for years.

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I find, therefore, that defendants' records comply in every respect with the terms of the three claims of Edison patent No. 482,462, and secure the same advantages that said patent recites. Those records, in my opinion, are the complete equivalents of the records embraced by each of said claims.



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Q. 7. Please compare Complainants' Exhibit Defendants' Record with the Edison patent No. 414,761 involved herein, and state whether or not the said record embodies the invention described and illustrated in said patent and covered by the first and third claims thereof?

A. The patent to which you refer, like those which I have already considered, relates to movable or separate phonograph records and blanks.  
110 The patent refers to blanks of the kind described in Edison patent No. 382,418 having smooth continuous tapered bores, and calls attention to difficulties experienced in the manufacture and finishing of such records. For instance, the Edison patent No. 414,761 says (line 59 *et seq.*):

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"In the process of molding the blank while the material cools, it sometimes becomes contracted or warped on its inner surface, so that it does not fit the phonogram cylinder truly, and and in this case it has to be reamed out to remove the irregularities. This has to be allowed for in making the blanks, and when the blank is made with a smooth interior, the whole inner surface often has to be cut in order to make it true, and this is a matter of some difficulty, and incurs a risk of injury to the blank."

112

In order to overcome this objection, as well as to secure positive advantages, which the patent explains, and to which I shall refer, the invention of the patent in question consisted in making the tapered bore of a series of ribs or projections; in other words, that invention consisted in removing so much of the material on the interior of the record as was unnecessary to give the desired friction with the mandrel to cause the record or blank to be properly rotated with respect to the recording and reproducing devices. The particular arrangement of internal ribs or projections which the patent specifically describes as an embodiment of the invention, is a continuous spiral rib or thread running

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from one end of the record to the other. The patent refers to this specific arrangement of a spiral rib as being desirable when the blank is formed by a molding operation, since, as the patent says, "by slightly turning or screwing the same, it can be readily withdrawn" from the mold. The patent is, however, not limited to this specific arrangement of spiral rib. Having referred to the use of internal ribs or projections on the record or blank, and recited the objections which I have before quoted to the use of a smooth continuous bore, the patent (line 70 *et seq.*) says:

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"Where the blank is formed with an internal rib or ribs and such warping occurs, it is only necessary, in order to remove it, to cut away the edges of the ribs, and thus a blank having a true inner surface can be formed with less labor and expense and waste of material than where the smooth surface is used. I make the ribs always deep enough to allow for the reaming out of the cylinder. Another advantage is that when the blank is placed on the phonogram cylinder, any particles of dust or other foreign substance which may be on the cylinder enter and remain in the spaces between the ribs, instead of coming between the blank and the cylinder, where they might prevent the blank from assuming a true position and resting evenly thereon."

115

Another advantage which occurs to me, and which has been realized in practice, although not directly referred to in the patent in question, is that by removing the superfluous material on the interior of the record or blank, a lighter article is obtained and a very considerable saving in material can be secured. Since the material of which the records are made is relatively expensive, this is an important consideration, and lightness is of course also desirable. Of course if it were impossible to secure the desired friction between the mandrel and blank in any other way than by utilizing

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the entire interior surface of the record or blank for engagement with the mandrel, then Edison's invention of removing a part of the material from the interior of the record could not be utilized, but since the coefficient of friction between the record and the mandrel is sufficient to secure the necessary friction without the engagement of the entire interior surface of the record with the mandrel, then it becomes possible to adopt this important and ingenious expedient of removing the

118 superfluous material and thereby securing the several advantages to which I have referred. At the present time, in the manufacture of phonograph and graphophone records and blanks, a continuous spiral rib is not employed, but a series of concentric ribs or projections is used instead. The claims of the patent are, however, broad enough to include this latter construction, as will be obvious.

The first and third claims are as follows :

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" 1. A tubular phonogram blank provided with internal ribs or projections, substantially as set forth.

" 3. A tubular phonogram blank made of molded material and molded with ribs or projections on its inner surface, substantially as set forth."

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The first claim covers broadly any phonogram blank or record made in the general form of a tube and provided with internal ribs or projections which engage the phonograph mandrel, instead of with a smooth continuous bore as with the record or blank of the Edison patent No. 382,418. The third claim is limited to such a blank or record made of molded material, the ribs or projections referred to being integral with the record or blank and hence being formed by the same molding operation.

Referring now to defendants' records, I find that they are formed with internal ribs or projections which engage the mandrel with sufficient friction to properly rotate the record with respect to the recording and

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reproducing devices. In other words, with defendants' records the superfluous material on the interior of the blank is removed, thereby not only effecting a considerable saving in the weight of material in the blanks, but also securing the different advantages to which the patent in question refers. It is true that in the patent in question there are a series of supports on the interior of the blank or record for engagement with the mandrel, whereas with defendants' record the ribs or projections are formed only at the ends of the record. This, however, is not a difference of substance, since it is only necessary to make the ribs or projections of sufficient area or surface to give the desired friction when the record is engaged with the mandrel. It is perfectly evident that if two ribs of defendants' record did not give a sufficient frictional engagement with the mandrel to properly turn the record, it would only be necessary to employ one or more additional ribs intermediate of the same to secure the desired increase of area. When Edison suggested the feasibility of removing the superfluous material on the interior of the record or blank, his invention was, of course, not confined to any particular arrangement or number of ribs that might be used. Although the record shown in Fig. 2 of that patent is illustrated as employing nine ribs, it is evident that the invention is the same whether the record is provided with more or with less, and the invention is present just as effectively in a record which is provided with eighteen ribs, as it is in one employing only two ribs, as with defendants' construction.

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It is my opinion, therefore, that defendants' records embody the invention of the first and third claims of the patent in question, and are the full and complete equivalents of the constructions recited in said claims.

8 Q. I hand you a box or carton containing a phonographic record, and ask if you know what they represent?

A. The phonographic record is one of the records sold by the complainants, and the box or carton is one



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of the containers in which such records are marketed. The exhibit you hand me represents the commercial way in which Edison records are put up and sold.

9 Q. Do you find indicated on the box or carton containing this Edison record the dates of the three patents in suit which you have considered?

126 A. I do. The box or carton is covered by a label carrying the patent dates of May 8, 1888, and November 12, 1889, these dates being the dates of the patents in suit. A printed label which is enclosed with the record also contains these patent dates, and the records themselves are marked with the word "Patented."

The exhibit in question is introduced in evidence and marked "Complainant's Exhibit Edison Record and Carton."

127 Defendants' counsel admits that Complainants' Exhibit Defendants' Record referred to in the direct examination of the witness is a phonograph record made and sold by the defendants prior to the filing of the bills of complaint and subsequent to the acquiring of title to the patents in suit by the complainants.

CROSS-EXAMINATION BY MR. SHERIDAN :

10 x-Q. Does the inventor anywhere in the patent in suit No. 382, 418 speak of the use of any material other than "wax or a wax-like substance?"

128 A. No.

11 x-Q. In fact, does he not state positively, where he speaks of the material, beginning at line 35, "P represents phonogram blanks or phonograms. They have a cylindrical recording surface s, made of wax or a wax-like substance?"

A. You have correctly quoted from the patent. As I understand it, the expression "wax-like material" includes any material suitable for use in this art, as distinguished from tinfoil, for example, that was originally used by Mr. Edison.

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12 x-Q. What do you understand to be the meaning of the paragraph just preceding the claims in this patent?

A. The paragraph in question is a notice that certain specific features of invention which the specification describes are not embodied in the claims of that patent, since such features are covered by an earlier application filed October 21, 1887. The features of invention which are referred to are, first, "a phonogram blank having a recording surface of wax or a waxlike material," and second "such a surface mounted upon backing of tougher material," both of which are referred to in the specification. In other words, the paragraph in question is merely a cross-reference to another application, as is very commonly done in this practice. 130

13 x-Q. In other words, so far as this patent is concerned, it is a notice to the world that the only materials, or more properly speaking a record composed of the materials described in this patent was old at the date of the application for the patent? 131

A. The notice indicates that phonogram blanks having the peculiarities recited therein had been previously described in a pending application.

14 x-Q. Then so far as this patent is concerned, the only novel feature was the providing of an old record having a wax or waxlike surface with a bore tapered throughout its length; is that true or not?

A. I think that is correct.

15 x-Q. Defendants' record, as exemplified by the exhibit in this case, has an internal annular flange at each end; has it not? 132

A. I have referred to them as ribs, but flange is a perfectly proper expression.

16 x-Q. Can you tell, from an examination of the bores of these flanges, as to whether they are parallel cylindrical bores, or as to whether they are individually tapered?

A. The bore of these flanges appears to be tapered, so that a straight line can be drawn parallel to both bores. The question of similarity



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however, between defendants' record and the record of the patent under consideration, resides more in the fact that the ribs in defendants' record constitute a bore of the proper taper to engage the standard mandrel with sufficient friction to be properly rotated with respect to the recording and reproducing devices.

17 x-Q. In other words, you consider, without any question of doubt, that defendants' record is the  
134 obvious mechanical equivalent of the record shown and described in the patent under consideration?

A. Defendants' record, from my point of view, is the exact mechanical equivalent of the invention of Edison patent No. 414,761, which I have before considered. The invention of that patent was of the nature of an improvement on the invention of the Edison patent we are now considering, but it still retained the invention of the earlier patent in utilizing the tapered bore. I believe, therefore, that defendants' record is the full  
135 and exact mechanical equivalent of the invention of the Edison patent under consideration, although defendants have gone farther and have also utilized the improvement of the Edison patent No. 414,761.

18 x-Q. I am not asking you with regard to patent 414,761 just at present. That is in the companion suit, and I will reach it in its proper order. What I desire to know now is, as to whether you consider defendants' structure the full and obvious mechanical equivalent of the structure shown and described in the  
136 patent under consideration?

A. I consider defendants' record to be the full equivalent of the device covered by the Edison patent number 382,418. In view of the Edison patent No. 414,761, I consider defendants' record to be the obvious equivalent of the record covered by the Edison patent we are now considering.

19 x-Q. With regard to patent 382,462, which is also in this suit, do you not find these words, beginning at line 8: "I have found in practice that the most available surface for phonogram blanks and phono-

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grams is one composed of wax, gum, or other plastic compound?"

A. I do.

20 x-Q. Do you not also find that wherever it speaks of the material of which the surface of or the phonogram itself is composed—namely, on lines 16, 19, 20, 31, 35, 40, 43, 56, and in each of the claims, to be a wax or wax-like substance?

A. The specification appears to refer only to wax or wax-like materials, and is, in my opinion, entirely 138 comprehensive.

21 x-Q. Was it not true, at the date of this invention, that one of the reasons why a phonogram should have this wax-like characteristic, was that it should be susceptible to the impressionable or engraving action of a stylus?

A. No, I think not. The proper material was one that should be hard enough to be durable, and smooth enough to give satisfactory reproduction. Of course, if all records were original records, the surface ought 139 to be sufficiently soft to be cut by the recording device; but phonograph records are not all originals, and the possibility of making duplicates has been recognized for many years. So that I answer your question by saying that the phonogram blank need not be made of material particularly designed as an original record, but can be made of any wax-like material. You probably know that celluloid can be used for making original records.

22 x-Q. What is the usual construction properly 140 placed upon the word "wax" or "wax-like" by the English language?

A. So far as physical properties are concerned, a wax is an amorphous material, solid at ordinary temperatures, varying in hardness according to different varieties, of many shades of color, more or less brittle when subjected to considerable cold, and more or less plastic when subjected to heat. A waxlike material, to my mind, might be a material having any of these characteristics, since that expression is broad, but for



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the purposes of this case I consider a waxlike material to be any amorphous and sufficiently hard substance suitable for use as a phonographic record. It does not seem to me that we are dealing so much with material in the consideration of these patents as we are with mechanical constructions.

Adjourned to Wednesday, January 22, 1902, at 10 A. M.

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NEW YORK, January 22, 1902.

Met pursuant to adjournment.

Present—Counsel as before.

CROSS-EXAMINATION OF MR. FRANK L. DYER RESUMED :

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23 x-Q. The previous patent 382,418 shows and describes a blank phonogram, the outer surface of which is formed of a wax or waxlike material, does it not?

A. It does.

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24 x-Q. And this patent contains the disclaimer to which you have already referred, that such a phonogram or a phonogram formed entirely or in part of wax or waxlike materials, was old in the art as early as October 21st, 1887, a date earlier than the date of the application in suit, is not that true. I refer, of course, to the patent under consideration.

A. Yes, the patent in question No. 382,418 contains a notice in the form of a disclaimer that such records or blanks had been made the subject of an earlier application.

25 x-Q. Then all that the present patent which you are considering shows over the patent and disclaimer to which I refer, is a record made entirely of wax, is not that true?

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A. The difference between the Edison patent 382,462 and the prior art as I understand it, is that the prior art employed a backing of paper or other tough material and a coating of wax or waxlike material, while the patent covers a blank or record made of wax or waxlike materials and having the same coefficient of expansion throughout its mass. For the purposes of this case, it can be assumed that the difference between the patented record and the prior record is that the former is made of wax or waxlike materials throughout, although, as I have said in my direct examination, the patent is not limited to the making of the record of the same material throughout. Perhaps the best distinction between the patented record and the prior record is that the latter was made of two materials having different coefficients of expansion, whereas the patented record is made of one or two materials having the same coefficient of expansion.

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26 x-Q. Does the prior patent state what material the backing was made of?

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A. By "the prior patent" I assume you mean the Edison patent No. 382,418. This patent does not state the particular material for the backing, but refers to it only as "tougher material."

27 x-Q. Could not the claims contained in both the Edison patents we have been considering so far have been predicated upon the description and drawings of patent 382,462?

A. If Mr. Edison, when he filed his application for patent No. 382,418, had made his invention which he later embodied in the application for his patent No. 382,462, I see no reason why both inventions could not have been embodied in the same application.

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28 x-Q. Do you know of any reason why a record formed with a surface of celluloid upon a backing of different material having a different rate or coefficient of expansion would not work?

A. That is a construction that is not used by defendants, and I have therefore not had occasion to consider it from my own knowledge



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however, I am unable to say whether the construction you refer to would be satisfactory or not.

29 x-Q. The objections or objectionable features which you state Mr. Edison overcame by his invention as set forth in patent 382,462, existed only in phonograms made partly of a wax or wax-like material, so far as you know; is not that true?

150 A. The phonograms to which you refer appear to be the only ones which Mr. Edison specifically criticised in the application for the patent in question.

30 x-Q. Defendants' record is formed of celluloid or similar material, is it not?

A. I so understand it.

31 x-Q. Supposing that defendants had a patent for a record formed of celluloid or similar material, do you think its terms would be comprehensive enough as to cover or include a record made of wax or wax-like material?

151 A. That is a question which I think depends entirely upon the language of the supposed patent and of its claims, as well as upon its date and its bearing with reference to the prior art, and also as to the construction and character of the assumed record. As I am not advised as to any of these points I am unable to express any opinion in the matter.

32 x-Q. With regard to patent 414,761, it relates to the same kind of a phonogram as is shown and described in patent 382,462, which you have just considered, does it not?

152 A. Yes; this patent also relates to removable phonograph records and blanks.

33 x-Q. The only difference between the structure shown and described in this patent over the two patents previously considered, is that it shows a spiral rib throughout the length of its internal bore; is not that true?

A. The patent in question illustrates a record or blank as being provided with a spiral rib extending throughout the length of its bore, but the patent refers broadly to "providing the interior of the cylindrical

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phonogram blank with ribs, flanges or projections"; the first and third claims are not limited to the spiral rib.

34 x-Q. And this spiral rib was provided for two purposes; to avoid the objectionable feature of dust interfering with the close fitting of phonogram and mandrel, and to provide for sustaining the part or main body of the phonogram throughout its length; is not that true?

154

A. No, I think not. So far as the spiral rib is concerned, Mr. Edison apparently regarded it, at the time the application was filed, as the preferred construction, because when the blanks are molded the core could be very easily removed, as the patent says, "by slightly turning or screwing the same." At the present time, Edison records are formed with concentric flanges or ribs which are arranged paralld with each other. This is true also of defendants' record. The provision of phonograph records or blanks with any proper arrangement of "ribs, flanges or projections," secures all the advantages incident to the construction, except the capacity of readily removing the core by unscrewing it, which appears to be true only of the spiral rib. The advantages due to the broad invention are not restricted to the ease with which the record or blank can be inserted over the mandrel, even when the latter is coated with dust or foreign particles, but include the other and equally important advantages which I have referred to of saving material and reducing the weight. So far as the feature which you speak of, of sustaining 155 the main body of the phonogram throughout its length is concerned, it is obvious that this is not necessary if the body of the record or blank is sufficiently rigid to be supported at the ends, as is done, for example, in defendants' records, and as could be done with other records.

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35 x-Q. Does the patent under consideration say anything about saving of material?

A. Apparently the patent considers this as being so obvious as not to require a special reference.



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36 x-Q. Does not the patent under consideration actually show a phonogram made with a greater amount of material than that shown in patent 382,462?

A. So far as the drawings of the patents in question are concerned, that is correct.

37 x-Q. The patent does not show or describe end flanges similar to the internal end flanges of defendants' record, does it?

158 A. The patent does not specifically show or describe any other arrangement than a spiral rib, but, as I have before said, refers broadly to "providing the interior of the cylindrical phonogram blank with ribs, flanges or projections." It does not specifically describe and illustrate the arrangement of the invention adopted by defendants.

FRANK L. DYER.

159 Complainants' counsel notifies defendants' counsel that complainants' *prima facie* case is closed.

It is stipulated that the certificate to the foregoing deposition may be omitted.

160

F. L. Dyer.

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## UNITED STATES CIRCUIT COURT,

NORTHERN DISTRICT OF ILLINOIS—NORTHERN DIVISION.

EDISON PHONOGRAPH COMPANY,  
Complainant,

vs.

LAMBERT COMPANY and THOMAS B.  
LAMBERT,  
Defendants.

In Equity.

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NATIONAL PHONOGRAPH COMPANY,  
Complainant,

vs.

LAMBERT COMPANY and THOMAS B.  
LAMBERT,  
Defendants.

In Equity.

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Testimony in rebuttal for complainants, taken before  
John R. Taylor, Esq., Notary Public and Special Ex-  
aminer by consent, at No. 31 Nassau street, in the City  
and State of New York.

NEW YORK, June 5th, 1902. 164

Met pursuant to waiver of notice.

Present—

RICHARD N. DYER, Esq., for complainants.

THOMAS F. SHERIDAN, Esq., for defendants.

FRANK L. DYER, being duly sworn in both cases,  
deposes and says as follows:

DIRECT EXAMINATION BY MR. DYER:

1 Q. You have already testified, I believe, as an  
expert in both of these cases?



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A. I have.

2 Q. Were you familiar with the original graphophone manufactured by the American Graphophone Company prior to the advent of the modern phonograph with tapered mandrel and soap blank?

166 A. Yes, sir. About the year 1887, as I stated in my previous deposition, I became familiar with the original graphophone, and had occasion at that time, and during the succeeding two or three years, to frequently examine those machines. My recollection of the mechanical construction of the original graphophone is very clear. The machines in question I examined and experimented with in Washington, D. C., at the office of Mr. Edward D. Easton, who is prominently connected with the American Graphophone Company at the present time.

3 Q. Please consider the patents relating to the graphophone which were granted prior to the issue of the patents in suit, and outline in a general way the development of the graphophone as disclosed thereby, so far as relates to the form of the record or blank and the manner of supporting and sustaining the same?

167 A. The first graphophone patent was granted to Chichester A. Bell and Sumner Tainter on May 4th, 1886, No. 341,214, the application for which was filed June 27th, 1885. In this patent Bell and Tainter describe the formation of a phonographic record in a wax surface by the scraping action of a chisel-like recorder, as distinguished from the early Edison phonograph in which the record was formed by the indenting action of a needle in a yielding foil or similar material. The patent in question describes a record or blank in the form of a disk composed of a layer of paper, say one-tenth of an inch in thickness, supplied with a coating of wax composition (beeswax and paraffin) of about one-twentieth of an inch in thickness. Such a record or blank would be very objectionable, as it would inevitably curl, wrinkle and warp under changes in temperature.

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Bell and Tainter apparently recognized this defect in their early experiments, because in patent No. 341,288 granted to Sumner Tainter on the same date (May 4th, 1886), the application for which was filed December 4th, 1885, a separate cylindrical record is described. This record was formed of a cylindrical paper tube thinly coated with a composition of beeswax and paraffin, and was the first suggestion in the art, so far as I know, of a removable separate record, constructed as a distinct article of manufacture, and intended to be placed in position and operated upon in a recording instrument, and employed indefinitely in a reproducing apparatus for securing sound reproduction. In order to properly support the record, the graphophone of this patent was provided with a truly cylindrical mandrel with which the record was engaged. Obviously if the record was to be properly supported, its internal diameter would have to correspond identically with the external diameter of the mandrel, in order that the friction between the two might be sufficient to rotate the record. Such a close fit between the record and mandrel would make it a slow and tedious operation to insert the record on the mandrel or to remove the record. Owing to the hygroscopic nature of paper, these difficulties would be very much increased in damp weather. Furthermore, since the paper record would be likely to become warped under the effect of thermometric changes one could never be assured that the desired fit between the record and mandrel could be always relied upon, and under some conditions the records would be too loose to be turned frictionally, and under other conditions they would contract so as to be prevented from slipping properly over the mandrel.

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These difficulties were no doubt realized in the experiments with the graphophone, because a third patent was granted on December 27th, 1887, to Tainter, No. 375,579, on an application filed July 7th, 1887, in which a cylindrical record was engaged *loosely* with a cylindrical mandrel and was caused to rotate by being



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jammed against a shoulder at one end thereof. In this way, by making the mandrel small enough, there would be no trouble in always slipping the record easily over the same, but the suggestion of rotating the record by engaging one of its ends with a shoulder, presented new and equally serious difficulties. In the first place, if a record were engaged in this way with an inclined shoulder, the friction between the two would be very slight unless the record were jammed very tightly in

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place, so as to distort it at one end and probably crack the delicate record surface. In the next place, the other end of the record would be unsupported, and under the pressure of the recording and reproducing devices would wobble, so as to turn eccentrically with respect to the mandrel. And finally, this wobbling of the record on the mandrel would, in two or three rotations, work it loose so that it would no longer turn. Here again it appears very clearly that the early

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experimenters with the graphophone were simply floundering in the dark in their efforts to secure some way by means of which the record could be properly supported and at the same time readily placed in position with respect to the recording and reproducing devices or removed from that relation.

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The final advance made in the development of the graphophone in the respect under consideration is disclosed in the patent to Tainter, No. 380,535, dated April 3, 1888 (a little more than a month prior to the issue of the Edison patent on tapered blank No. 382,418). The application for the Tainter patent was, however, filed December 2d, 1887, or about a week subsequent to the original Edison application. In this Tainter patent the same separate cylindrical record is employed, but the mandrel of the earlier graphophone patents no longer appears, the record being supported at each end by means of heading disks which project slightly within the record bore. One of these disks is rotated by suitable gearing, and the other is driven from the record, the latter disk be-



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ing spring-pressed, so that it may be withdrawn to permit the record to be removed. This is the arrangement that was used in the early commercial graphophones, and its use was continued in those machines until the superiority of the Edison construction put the Graphophone Company to the necessity of adopting it. The objections to the employment of supporting disks, as disclosed in the Tainter patent No. 380,535, are principally that the record is insufficiently and uncertainly driven, since the friction of one of the disks is comparatively slight, while at the same time the records have to be of substantially uniform length, which is not the case when the record is tapered, as suggested by Edison. 178

A review of the patents to which I have referred shows that from June 27th, 1885, up to December, 1887, the workers in the graphophone art were striving to find some suitable way for supporting and rotating the record, and at the latter date only had hit upon the suggestion of employing end disks for the purpose, which were subsequently abandoned in favor of Edison's invention of providing the record with a tapered bore arranged to engage a similarly formed mandrel. 179

The original graphophone, which I was familiar with as early as 1887, made use of these supporting disks for carrying and rotating the removable cylindrical record. The Edison phonograph with the so-called spectacle frame appeared sometime in 1888, and that is the machine which I refer to in my direct examination as having been used by me for the purpose of securing phonographic records in the Korean Legation at Washington. The Edison commercial phonograph appeared in 1889, and was substantially identical with the present phonograph, except of course in details which have been worked out since that time. Up to the appearance of the commercial Edison phonograph the original graphophones were in use, and I had occasion frequently to see them. When, however, the perfected Edison phonograph was put on the market, 180



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the graphophones practically disappeared, as they were so immeasurably inferior as to be incapable of effective competition with the phonograph. For a year or so after its introduction, the commercial Edison phohograph was practically the only talking machine on the market, and it was not until about 1891 or 1892, as I now remember, that the present graphophone was constructed in competition with that machine, and in which the old cylindrical graphophone records sustained by end disks no longer appeared, but instead thereof the Edison soap record with tapered bore sustained on a tapered mandrel was employed. Suits were thereupon brought on the Edison patents herein involved against the manufacturers of the graphophone, and resulted in the taking of a license under those patents by such manufacturers.

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In order that we may be advised as to the history of the present graphophone records which embody this invention of Edison, it is not necessary for us to indulge in idle speculation, as the patent records show more eloquently than words the futile struggle towards success and the ultimate appropriation of Edison's suggestion. First we have the original disk record, then the cylindrical record tightly fitting a cylindrical mandrel, then the cylindrical record loosely fitting a cylindrical mandrel with an inclined shoulder at one end, and finally the dropping of the mandrel altogether and the supporting of the cylindrical record by means of disks. Then appeared the Edison phonograph embodying the tapered bore construction, which shortly drove the grapophone out of the market, and we finally have the reappearance of that instrument embodying, not the record of Tainter, but the tapered bore record of Edison.

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4 Q. Have you read the testimony of Henry W. Carter, the expert who testified for defendants in these suits?

A. I have.

5 Q. Please consider so much of Mr. Carter's deposition as relates to Edison patent No. 382,418 in con-

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nection with the several exhibits referred to by him, and state whether or not you agree with Mr. Carter's conclusions as to this patent, and if not, then give your reasons why you entertain a different opinion?

A. I do not agree with Mr. Carter in his conclusions as to the patent in question, and I do not believe that Mr. Carter, in considering the patent, was familiar with the development of the phonographic art and that he therefore appreciated the difficulties under which the inventors labored in order to bring that art to its present state of perfection; in fact, Mr. Carter says, in answer to x-Q. 145, that his "first actual experience with phonographs and phonographic records and blanks occurred in the winter of 1891-2." 186

Mr. Carter nowhere questions the substantial identity of defendants' records with the invention of the patent under consideration, nor could he, of course, do so since defendants' records are tapered so as to fit the mandrels of standard phonographs and graphophones. He also does not question the novelty of the invention of this Edison patent, as appears from his cross-examination: 187

"x-O. 24. Do you find any instance in the prior art where a phonogram record or blank has been tapered on its bore and engaged with a tapered mandrel so as to rotate by friction?

"A. I find in the Tainter patent No. 375,579, filed July 7, 1887, and granted December 27th of that year, a phonogram blank frictionally held upon a tapered mandrel, so as to rotate therewith by friction. This phonogram blank did not have a taper bore, and in this respect the prior art does not disclose the construction you refer to in phonogram blanks or records, so far as I am aware. 188

"x-Q. 25. So far as the prior art is concerned, it was a new suggestion then to make a phonogram record or blank with a tapered bore?

"A. Confining attention strictly to phonogram records or blanks, it was.



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"x-Q. 26. This includes, of course, graphophone records or blanks, or other cylindrical records or blanks for use with talking machines?"

"A. Certainly, I make no distinction between the products of different makers in this respect, but understand the word phonogram record or blank to cover such an article, wherever found or whatever it is called in the trade."

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While Mr. Carter, therefore, neither denies the substantial identity between defendants' records and those of the patent in question, nor the novelty of Edison's suggestion, he expresses the opinion that in view of certain practices in other arts, no invention was required on Edison's part to produce the tapered record or blank adapted to engage and frictionally rotate with a tapered mandrel. I shall consider the references to which Mr. Carter calls attention, and shall show that they disclose nothing in any way analogous to Edison's suggestion.

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But before doing so, it is not out of place to direct attention to the graphophone patents considered in my previous answer, which very clearly show that during a period of several years ingenious mechanics, striving to secure success, failed utterly in achieving it. All of the references to which Mr. Carter refers are many years prior in date to the first Bell and Tainter patent of May 4th, 1886, so that if Mr. Edison's invention were obvious to skilled mechanics, the taper bore construction would certainly have occurred to those inventors. It seems to me that

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Tainter's efforts for almost three years to make a satisfactory talking-machine record without hitting on the suggestion of tapering the bore of the record and engaging it with a tapered mandrel, constitute a most complete refutation of Mr. Carter's assertion that in view of the prior art that suggestion was obvious.

Of the exhibits referred to by Mr. Carter, those lettered respectively A, B, C, D, E, F, G, H, J and K relate to ordinary lathe construction and operation.



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Exhibits A, B and C show the ordinary tapered live and dead centres forced in tapered openings in the ordinary live and dead spindles respectively. Exhibits E, F, G, H, J and K illustrate the common expedient of forcing taper-socketed chucks upon the tapered ends of live centres. In these references there is nothing remotely analogous to Edison's suggestion of mounting a taper-bored record or blank on a tapered mandrel. Mr. Carter argues that :

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" If the outer or enclosing part is turned off concentrically with the axis of its socket, it is a cylinder having a concentric taper bore ; and this cylinder is then in every essential the claimed invention of this Edison patent No. 382,418, in so far as that patent is alleged to contain any feature of novelty."

Mr. Carter does not make it clear as to the meaning of the expression "outer or enclosing part," nor does he refer to any specific prior instance 195 where the suggestion has been made of turning off a "part" concentrically with the axis of a taper socket. I assume, however, that Mr. Carter had in mind the common expedient of mounting a taper-socketed chuck on a taper arbor, as shown, for example, in Defendants' Exhibits H and K ; at any rate these exhibits, of all that Mr. Carter has referred to, most nearly comply with the conditions of his statement. If, therefore, by the expression "outer or enclosing part" is meant an ordinary taper-socketed 196 chuck, then Mr. Carter fails to perceive that such a chuck is not "turned off concentrically with the axis of its socket" and would never be so formed, so that obviously, on his own admission, it could never be the equivalent of the Edison tapered bore record or blank. Furthermore, the taper-socketed chuck in lathe practice is not a piece of work on which a cutting operation is performed, as is the case with a taper-bored phonograph blank, nor does it carry a record surface or anything remotely suggestive thereof, from



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which sounds are reproduced, as with a phonograph record, but it is a separate tool which itself supports the work which requires to be operated upon. Mr. Carter practically admits this:

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"x-Q. 35. Do you find, prior to the patent in suit, any instance in any art—analogue to phonographs or not—where taper-bored work has been carried on a taper mandrel by friction, the work having a cylindrical outer surface concentric with the bore?"

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"A. That depends on what you call 'work.' Almost all chucks of the character I have referred to and such as are shown in the exhibits have a cylindrical outer surface concentric with the bore, and, as before pointed out, are carried on a taper mandrel by friction. The dental polishing tool of Locke shown in patent No. 170,178 has a polishing sleeve D of sand paper or the like, which has a tapered bore and is supported on a taper mandrel by friction. This sleeve has a conical outer surface, which is one form of cylinder in the broad sense of that term. Moreover, every twist drill almost—and a great variety of other tools—possesses essentially all of the elements of the construction you assume, considered with respect to their ordinary mounting, which is by the insertion of a tapered shank on the drill in a taper socket in the supporting spindle of the lathe or drilling machine. The outer surface of twist drills is cylindric and is perfectly concentric with the tapered shank, and, as I have previously pointed out, it is a mere reversal to make the taper socket on the driven part or work and the taper spindle on the mandrel, instead of placing the taper socket in the spindle or mandrel and the interfitting tapered shank on the driven tool or drill."

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It seems to me that the entire character of Mr. Carter's deposition is disclosed by this answer. Here

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he was given the opportunity of finding in the prior art any instance where any cylindrical work with a tapered bore is held frictionally on a tapered mandrel, and he refers to only three instances as showing that construction. The reference to chucks and to twist drills is obviously beside the point, because, as I have already said, chucks and drills are separate tools, which are never acted upon in any way even remotely analogous to the cutting of the sound record on a blank, or which of themselves operate in any way analogous to the reproducing action of a phonograph record. Furthermore, not a single reference referred to by Mr. Carter discloses a chuck having a cylindrical surface. So far as the patent to Locke is concerned, Mr. Carter admits that the polishing sleeve thereof is not provided with a cylindrical outer surface, but is in fact conical, being nothing more nor less than a thimble of sand paper forced over a tapered shank.

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The only other exhibit in lathe practice referred to by Mr. Carter which I have not considered is Defendants' Exhibit D, but this Mr. Carter regards as

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"perhaps not quite so much in point, for the reason that the essence of the claim of the patent No. 382,418 relates to the taper bore, and not to a tapered mandrel (although, of course, a taper mandrel is necessarily implied as a means of using the taper-bored blank), whereas Exhibit D, while it shows a tapered mandrel, does not show a tapered bore in the work placed upon the mandrel, except as the bore of the work is forced into a tapered shape by the compression of the material surrounding it when wedged upon the mandrel."

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In Exhibit D, as appears from the text of "Modern Machine Shop Practice," the mandrel is given a hardly perceptible taper (only 1 in 8,000, as Mr. Carter admits x-Q. 12), and the purpose of this slight taper is stated to be :



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"to accommodate any slight varying in the diameter of holes bored by standard reamers, which gradually reduce in diameter by wear."

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In other words, if these standard reamers did not vary in diameter, a perfectly cylindrical mandrel would be used. Obviously it would be impossible to properly support a cylindrically-bored metal cylinder on a mandrel having any considerable taper, for the reason that in that case only one edge of the work would engage the mandrel, and the work would be carried in the same wobbling manner that characterizes the supporting of the graphophone record in Tainter patent No. 375,579 before referred to. Mr. Carter is, therefore, quite right in practically excluding Exhibit D from the prior art, as it shows absolutely no equivalent for the taper bore, which is the vital feature of the patent in question.

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Having referred to expedients in lathe practice which he regards as analogous to the supporting of a phonograph record or blank on a tapered mandrel, Mr. Carter expresses the opinion that these prior suggestions fairly anticipate the invention of the patent, for the reason that :

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"A phonograph is nothing in the world but a special form of turning lathe, while the phonogram blank is merely a special kind of cylindric work which is cut in a particular manner by this special lathe, and which, in order to be thus cut, is placed upon a taper mandrel just as the work to be turned out in a lathe is mounted."

In expressing this opinion, Mr. Carter has fallen into three errors, to which I shall briefly call attention :

In the first place he mistakes the facts when he says that the phonogram blank "is placed upon a taper mandrel just as the work to be turned in a lathe is mounted." As I have already pointed out, he admits under cross-examination that there is no instance in lathe practice where the work is supported in any way analogous to

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the mounting of a phonograph record or blank as suggested by Edison. In making this statement he could not have had in mind the mounting of taper-socketed chucks or twist drills on tapered arbors, for the reason that a chuck or drill is not cylindrical, is not operated upon like a phonograph blank, and does not of itself perform work, as is the case with a phonograph record, but, as I have said, it is merely a special tool which supports the work or which carries other tools, like a drill, for operating upon the work. He also cannot 210 have had in mind the practice disclosed in Defendants' Exhibit D, because with that exhibit the work is not taper bored, nor is the mandrel perceptibly tapered, for which reasons the exhibit in question has been practically withdrawn.

In the second place, Mr. Carter, in expressing his opinion, is in error in assuming that a phonograph is a lathe or is in any way analogous to a lathe. With a lathe, the cutting tool is rigidly mounted in a carriage and does not partake of movement with respect to the 211 same. In a phonograph, the recording or reproducing device which is carried with respect to the work is also vibrated radially many thousand times per second. In a lathe, the surface speed with which the work may move with respect to the cutting tool is unimportant; whereas with the phonograph, the record or blank must be turned at an absolutely uniform speed in order that the pitch of the sounds may be accurately recorded or reproduced.

Finally, Mr. Carter errs in his opinion when 212 he compares the taper-bored blank or record of the patent in question supported on a taper mandrel with the work carried in known ways in lathe practice, for the reason, which Mr. Carter admits on cross-examination, that in the latter art no instance has been given of the mounting of any taper bored cylindrical element on a tapered mandrel, and which element is either operated upon in a way analogous to the recording of sounds on a phonogram blank,



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or which itself performs work in any way analogous to the reproducing of sounds from a phonograph record.

If, therefore, it be admitted, not as a fact but only as a matter of argument, that a phonograph is analogous to a lathe, it is not a fact, nor is it apparently advanced as such, that any instance in lathe practice has been produced by defendants that can be regarded as in any way analogous to Edison's suggestion of making a phonograph record or blank with a taper bore and supporting it frictionally on a taper mandrel, which suggestion, as I have before pointed out, has been bodily appropriated by defendants herein.

In addition to the references in lathe practice, defendants have also referred to the Tainter patents numbered 341,288 and 375,579 respectively, which I have already considered. Concerning the first of these patents, Mr. Carter admits (x-Q. 31) that there would be greater necessity for close fitting between the record and mandrel than if the record or blank were taper bored, and he also admits (x-Q. 33) that the record or blank could not be as readily removed in the former as in the latter case. With regard to the second Tainter patent, No. 375,579, he admits that the construction thereof is not desirable (x-Q. 42), but says that he is

"not surprised that almost immediately it was followed by the tapered bore construction disclosed in the Edison patent."

In volunteering this additional information, Mr. Carter loses sight of the fact that from June, 1885, up to December, 1887, Taintor was striving to find a way to properly support his graphophone record, and at the latter date had only succeeded in devising the impracticable scheme of employing two end disks, which were subsequently driven out of the market when the commercial Edison phonograph appeared on the scene. It was not correct, therefore, to say that Edison's taper bored construction appeared almost immediately after the use by Taintor of a cylindrical record, because the fact is that the perfected construc-

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tion was not suggested for almost two years after the cylindrical blank had been invented. Furthermore, during this period the suggestions—

“ of mounting tapered live and dead centres in taper live and tail spindles, and of mounting taper-socketed chucks on plug arbors, were well known and of common knowledge ” (Carter, x-Q. 34),

in view of which fact I think the statement that the Edison invention was an obvious one, is completely and positively disproved. 218

Additional references on which Mr. Carter relies in anticipation of the very simple invention of the patent in question are, first, the patent to Birkmann No. 309,288 of December 16th, 1884 ; second, the patent to Abbe No. 277,097 of May 8th, 1883 ; third, the patent to Locke No. 170,178 of November 23d, 1875 ; fourth, the patent to Phillips No. 70,113 of October 22d, 1867 ; fifth, the “ Bobbin-Winding Device of the Old Wheeler & Wilson No. 8 Sewing Machine ” ; and finally, the “ Hour Hand of an Ordinary Clock,” which is referred to as “ another familiar example of this taper fit between rotating parts.” 219

**BIRKMANN PATENT.** This patent shows an ordinary taper-bored chuck supporting the tapered shank of a drill, and, according to Mr. Carter, it does not add anything to Defendants' Exhibits A to K inclusive (x-Q. 43).

**ABBE PATENT.** In this patent a polishing wheel is provided with an elastic hub which is forced over a taper mandrel. Mr. Carter is unable to say whether the hub is taper bored or cylindrically bored (x-Q. 50). 220

**LOCKE PATENT.** This patent relates to a dental-polishing tool in which a cap or cone of emery paper is slipped over a tapered arbor, being held in place by an interposed layer of rubber. The patent is entirely non-analogous to the phonographic art, besides which the polishing cone of Locke is not open-ended like a phonographic record or blank, nor is it provided with



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a cylindrical outer surface, as with the latter element.

PHILLIPS PATENT. In this patent a spool is carried on a tapered shaft. Considering this patent, Mr. Carter states (x-Q. 55) that :

" It has a bore tapered throughout its length and a cylindric outer surface concentric with the bore, and in this respect it is as closely related as any of the other references."

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In stating that the spool of the Phillips patent is taper bored, Mr. Carter goes entirely outside of the specification, in which no reference is made to the form of the bore. Spools, as is well known, are not taper bored, but are cylindrically bored. Since the specification of the Phillips patent states that the spool is placed on the shaft " by forcing the latter through the spool axially," it is quite clear to my mind that the spool is not taper bored, since in that case no " force " would be required to insert the shaft through the

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spool. The only ground upon which Mr. Carter bases his statement that the spool of the Phillips patent must be taper bored is that it

" would be cracked and the spool destroyed before its bore could ever be forced to assume a taper form of the degree shown in this drawing " (x-Q. 63).

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Nothing appears in the patent as to the material of which the Phillips spool is made, and it well might be formed of some elastic substance, as in the Abbe patent. Furthermore, the patent is entirely silent as to the amount of the taper of the shaft, so that the latter might be well within the elastic limits of wood. In thus construing the Phillips patent, Mr. Carter has no hesitancy in assuming that the taper of the shaft is so great, and the character of the material of the spool is so non-elastic, that the bore of the latter must be tapered ; yet, in doing so, he overlooks the common and obvious fact that spools are all cylindrically bored and not taper bored. A fair interpretation of the Phillips patent, in the absence of any definite



F. L. Dyer.

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statement as to the form of the bore of the spool, would be to assume that an ordinary cylindrically-bored spool was used, which was *forced* upon a shaft, the taper of which was not so extreme as to cause the spool to crack. In the absence of any definite description in the patent, therefore, as to the exact construction of the spool, I do not regard the patent as being in any way suggestive of Edison's invention. Furthermore, a spooling device is certainly non-analogous to the art of phonographic recording and reproduction, and Mr. Carter admits (x-Q. 55) that it is "not as closely related to the phonographic art as is the art of turning and lathe work."

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WHEELER & WILSON NO. 8 SEWING MACHINE. This machine was examined by Mr. Carter about a month previous to the time when his deposition was given (x-Q. 71), so that it does not antedate the Edison patent. Concerning the bobbin of this machine, Mr. Carter states that:

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"Apparently, at the time I saw it, it was tapered from the middle toward each end—i. e., it was worn out to a larger diameter towards each side of the bobbin, as by being repeatedly forced upon the tapered spindle indiscriminately from either side."

Obviously, this requires no further comment.

CLOCK HOUR HAND.—Although Mr. Carter states in his direct examination that the "sleeve which supports the hand" is "ordinarily bored out on a taper to fit over the rotating sleeve of the clock movement," yet I observe on cross-examination he was not personally familiar with this practice prior to the date of the Edison patent (x-Q. 73), nor is he able to make any definite statement of a knowledge "of the sleeve of a clock movement for receiving the hour hand being made with a taper" (x-Q. 75).

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I have thus reviewed so much of Mr. Carter's deposition as relates to the patent to which your question



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has been directed, and have shown, from a reference to the patents illustrating the development of the graphophone, that Edison's invention of the taper-bored phonographic record or blank supported on a taper mandrel was not obvious. Of the several references to which Mr. Carter refers as disclosing practices, which he regards as analogous to Edison's invention, I have shown that even if we admit that the prior arts are analogous to the phonographic art, yet

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no disclosure of anything similar to Edison's suggestion had been made prior to the date of the patent in suit. In view of these facts I am unable to agree with Mr. Carter in his conclusion, which he thus states:

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"It thus appears that the phonogram blank of this Edison patent was to all intents and purposes the old phonogram blank of the Tainter patent, that it was practically identical in construction and absolutely identical in operation with the old blank, and all Mr. Edison did to it was to avoid the necessity of its being carefully fitted to the cylinder or mandrel of the phonograph so as to be of the same exact diameter on the interior as such mandrel was on its exterior, by employing the ordinary expedient which was generally employed by mechanics in similar situations everywhere of making the bore wedge-shaped or tapering to fit a correspondingly tapered supporting mandrel, and that the adoption of this well-known expedient could call for any exercise of the inventive faculty is a proposition which needs only to be stated to reveal its absurdity."

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On the contrary, the facts appear to be otherwise than as stated by Mr. Carter. The blank or record of the patent under discussion is *not* "to all intents and purposes the old phonogram blank of the Tainter patent," for the reason that it is a blank or record the essential and avowed purpose and intent of which is to be capable of ready engagement with and disengage-



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ment from the mandrel, and hence the very antithesis of the Tainter construction. It is *not* "practically identical in construction" with the old blank, for the reason that one is taper-bored and the other cylindrically-bored, and one is received on a tapered mandrel and the other on a cylindrical mandrel. It is *not* "absolutely identical in operation with the old blank," for the reason that it is readily applied to or withdrawn from the mandrel, and always retains its firm frictional engagement therewith under all conditions of climate and temperature; while the other is, under the most favorable conditions, only with difficulty applied to or withdrawn from the mandrel, and, under some conditions, is so loose as not to turn frictionally, while under other conditions it cannot be engaged with the mandrel at all. It, furthermore, is not a fact that Mr. Edison adopted "the ordinary expedient which was generally employed by mechanics in similar situations everywhere," for the reason that no instance has been given where anything analogous to a phonograph record or blank, or in fact any similar cylindrical object, has been supported, as suggested by Mr. Edison. And, finally, not only did the suggestion of a taper-bored blank or record frictionally engaging a tapered mandrel involve invention, in my opinion, and invention of a very meritorious character, since it made the modern phonograph a success; but that invention was made only after other ingenious inventors had been struggling for a number of years towards the goal without receiving any light from the prior art, and who in fact, even when that invention was made, were still following the wrong path. I therefore regard the patent in suit as disclosing a new and useful invention of the highest industrial importance and which I have shown drove the old graphophone out of the market. This being so, I see no reason to change the view formerly expressed, that defendants' records are the exact mechanical equivalents of the patented invention, in which respect Mr. Carter is apparently agreed with me.

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6 Q. Please consider so much of Mr. Carter's deposition as relates to Edison patent No. 382,462 in connection with the several exhibits referred to by him, and state whether or not you agree with Mr. Carter's conclusions as to this patent, and if not, then give your reasons why you entertain a different opinion? In answering this question you may also refer to any prior patents which may throw any light on the character of materials for making phonographic records or blank suggested prior to or contemporaneously with the patent in suit.

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A. I do not agree with Mr. Carter in the conclusions which he reaches concerning this patent. As I understand Mr. Carter's views, he expresses the opinion that defendants' celluloid records are not the equivalents of the record of his patent, for the reason that they are not constructed "wholly of wax or waxlike materials," and second, that the record of the patent was not a patentable invention. Concerning this latter question he says :

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" And in this connection it will be noticed that there can be no contention made here of a long felt want which others recognized but were unable to fill, the fact being that this patent was brought out at the very infancy of the art, and is in itself proof that the want was immediately felt and as immediately and naturally supplied. \* \* \* The progress in the development of the art from a wax-surfaced cylinder merely to one constructed wholly of wax, because made so thick as to require no strengthening backing, was thus but a natural mechanical sequence which must inevitably have occurred regardless of any particular workers along this line."

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He says, however (x-Q. 145) :

" I have no knowledge whatever of this development, except that which I gained from a study of the patents relating to this art, all of

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which, issued prior to 1890 or '91, I have examined more or less carefully."

Now as I have already pointed out the first composite graphophone records with paper backings and wax surfaces were first disclosed in cylindrical form in the Tainter patent No. 341,288, filed December 4th, 1885. The Edison application for the patent under consideration was not filed until January, 1888, so that a period of more than two years elapsed before the latter invention was made, during which time Tainter and his associates were diligently striving to perfect the graphophone, and during a part of which time Edison himself was working towards the perfection of the phonograph. By January, 1888, the phonographic art was not in its "infancy," but, in fact, had been continuously developed during the preceding three years, and shortly afterwards (in the summer of 1888) the "spectacle" phonograph was produced, which, except in small details, was a commercial and perfected instrument. I do not think, therefore, that Mr. Carter's argument that the invention of the patent under consideration was obvious is borne out by the facts, for the reason that, as I have shown, it was produced only after a number of years of uninterrupted work in this field by very able inventors working independently of Mr. Edison.

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On the question as to the substantial similarity or non-similarity between defendants' celluloid records and the patented invention, Mr. Carter attempts, by way of argument, to put a construction on the patent that will exclude defendants' structure from the scope of its claims. The only question at issue between Mr. Carter and myself is as to the meaning of the expression "wax-like" as it appears in the specification and claims. Obviously, "wax-like" is a very broad expression, and if given its rational meaning would include any material having any of the attributes of wax. Thus, a material which looked like wax would be wax-like in appearance; a

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material which smelled like wax would be wax-like in odor; a material having the physical structure of wax would be wax-like in its molecular form; a material which became softened under the effect of heat, and friable under the effect of cold, would be wax-like in these respects; a material having the adhesiveness of wax would be wax-like so far as this capacity is concerned; a material having the substantially chemical composition of wax would be wax-like in its formula; and a material  
246 having the smooth, uniform, unglazed surface of wax would be wax-like in these attributes. Of course, the greater number of features in common with wax which a material possessed, then the more perfectly wax-like would that material be. But the patent does not state what necessary wax-like qualities the material should have to be included in the definition of the patent. Mr. Carter admits this on cross-examination:

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"x-Q. 128. And I understand that you are unable to say what qualities of wax may be admitted in a material which for the purpose of this patent would be included in the definition of a wax-like material?

"A. That is true."

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In view of the general language of the specification, when I considered the patent in my former deposition, I asked myself this question: What definition can be applied to the expression "wax-like," as will include all suitable materials capable of utilizing the  
248 invention of the patent in a commercial and practical way, and which possesses one or more of the attributes of wax? When, therefore, I was asked on cross-examination (x-Q. 22) what was the meaning of "waxlike," I answered:

"So far as physical properties are concerned, a wax is an amorphous material, solid at ordinary temperatures, varying in hardness according to different varieties of many shades of color, more or less brittle when subjected to considerable cold, and more or less plastic when

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subjected to heat. A waxlike material, to my mind, might be a material having any of these characteristics, since that expression is broad ; but for the purposes of this case I consider a waxlike material to be any amorphous and sufficiently hard substance suitable for use as a phonographic record. It does not seem to me that we are dealing so much with material in the consideration of these patents as we are with mechanical constructions."

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It does not seem to me that this definition in any way strains the language of the specification, and, as so construed, Mr. Carter admits that the invention is new, and that it includes celluloid. This appears from his cross-examination :

" x-Q. 116. Do you know of any instance in the prior art where a phonographic record or blank has been made of material having the same coefficient of expansion throughout, that material being sufficiently smooth to receive an accurate record stiff enough to make the record self-supporting, and durable enough to give a number of reproductions without objectionable wearing of the record ?

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" A. No.

" x-Q. 117. Would not a celluloid record be included in this definition ?

" A. Yes."

Mr. Carter objects to my definition on the ground that it covers "the widest range of substances from butter and cheese, on the one hand, to glass on the other." Among the materials also included in my definition Mr. Carter refers to hard rubber and lead. So far as butter and cheese are concerned, it is obvious that neither is a "sufficiently hard substance suitable for use as a phonographic record," unless, of course, a record made of these materials was maintained at an extremely low temperature, in which case either would certainly be waxlike. Concerning glass, Mr. Carter

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states that this material "is a most perfect example of an amorphous material corresponding to this (my) definition," which statement he supports by reference to Webster. He does not, however, quote Webster's definition of "amorphous," but has erroneously quoted the definition of "amorphism." "Amorphous" is defined by Webster as being "without crystallization in the ultimate texture of a solid substance," and hence is the direct antithesis of glass. This material, in fact,

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instead of being amorphous, as Mr. Carter states, is a most perfect example of a non-amorphous substance. A good illustration of the difference between an amorphous and a non-amorphous material is found in a comparison between natural chalk and so-called "French chalk." The former is a natural deposit resulting from the ossified bones and shells of micro-organisms, and when observed through a microscope these structures are clearly apparent. French chalk

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is formed chemically by precipitating carbonate of lime, and under the microscope is absolutely structureless. Natural chalk is hence referred to by chemists as non-amorphous, while precipitated chalk is distinguished therefrom as amorphous. Glass is therefore not an amorphous material, and hence is not included in my definition of a waxlike material as defined by the patent in question. So far as hard rubber and lead are concerned, I see no reason why they should not be regarded as waxlike, in the sense of the patent, and in fact I understand that Mr. Edison has made satisfactory

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records on both of these materials. After all, the particular attributes of the recording material with which we have most to do in producing a satisfactory phonographic record are its physical structure and the character of its surface. So long as the material is hard enough and is free from grains or fibres which would produce false vibrations of the recording device, or, in other words, so long as it is provided with a smooth and uniform (*i. e.*, waxlike) surface, then it is satisfactory for the manufacture of commercial phonograph



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records. Such a surface is certainly waxlike, and there would be no other expression which would more clearly and accurately define it.

In giving his view of the expression "waxlike," Mr. Carter adopts as satisfactory the definition of the term "waxy" in the Century Dictionary as "resembling wax or putty in appearance, softness, plasticity, adhesiveness, or other properties; waxen; hence pliable, yielding, impressionable." He admits on cross-examination (x-Q. A. 23 to x-Q. 89) that a waxlike material is one which resembles wax in any of these characteristics. Being asked (x-Q. 93) if it were not a fact that one of the common properties possessed by wax and celluloid alike is that each "presents under normal temperatures a smooth, unglazed surface," he answered that this was the fact, but that it was also true "of almost every other material which might be mentioned." Being then asked (x-Q. 94) to mention other materials "as closely allied to wax as celluloid," he referred to "wood, iron, stone, gutta-percha, unglazed pottery, vulcanite fiber, leather, paper and bone." Another property possessed in common between wax and celluloid is that each "softens by the application of heat and hardens by the application of cold," but Mr. Carter says (x-Q. 98) that this "is true of almost every material." Being then asked (x-Q. 99) if it were true of the materials referred to by him as presenting the same character of surface as wax, he answered that it was only true of stone, pottery and wood.

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Thus, of all the materials mentioned by Mr. Carter as having two characteristics of wax—namely, the waxlike quality of surface and the waxlike capacity of melting under the effect of heat, Mr. Carter's list is limited to celluloid, gutta-percha, stone, pottery and wood. Now, it is of course absurd to say that the three materials last referred to are waxlike in being readily softened by heat, since stone and pottery are amenable to temperature of only thousands of degrees; while it is equally absurd to say that wood is amorphous, since it is highly fibrous. When Mr.



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Carter's position on cross-examination is analyzed, therefore, it will be seen that he knows of only one other material which is as waxlike as celluloid, and that material is gutta-percha or hard rubber, which I regard as essentially waxlike and as being highly suitable for making phonograph records under certain conditions. Furthermore, Mr. Carter admits that, so far as appearance is concerned, he would not be able to distinguish between celluloid and paraffin wax (x-Q.

262 96).

Practically, then, Mr. Carter is forced to the position of finding in celluloid some *unwaxlike* quality which may, in his judgment, distinguish that material from the patented invention, although he acknowledges that celluloid is waxlike in several respects, and in fact, as appears from his cross-examination, is more nearly waxlike than any material of which he has knowledge, since the color of the gutta-percha would distinguish it from any known wax, which he admits is not the case with celluloid. In seeking to find in celluloid some unwaxlike quality, Mr. Carter reaches the conclusion that a phonograph record or blank, in order to be included in the language of the patent in question, must be formed of some material having waxlike properties and sufficiently soft to enable it to be cut or engraved by a phonographic recorder. He says:

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"At the time of and prior to this Edison patent therefore, the properties or characteristics most desirable or essential in the recording medium or phonogram blank were recognized to be those by which such blank lent itself most readily to the operation of being smoothly cut or engraved by the cutting style which produced the record groove, and as the substance which at that time seemed to most fully possess these essential properties or characteristics was wax or a waxy compound, this designation was employed in the art to describe and define the desired record tablet or phonogram blank material. And this I understand to be what Mr.

F. L. Dyer.

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Edison meant in the patent under consideration when he claimed his phonogram blank or phonogram 'constructed wholly of wax or waxlike materials', *i. e.*, a material having those waxlike qualities which rendered it capable of being readily cut or engraved to form the record, as distinguished from being simply indented like the old tinfoil record of his early phonograph."

And he also says:

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"But I do regard the words of the claim 'wax or waxlike' as necessarily and unavoidably demanding a material of such waxlike or waxy characteristics as will enable it to properly undergo the cutting operation by which the sound record is engraved upon the phonogram blank in the ordinary operation of the modern phonograph and in the ordinary method of producing phonograms for use in the modern phonograph."

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As a basis for this conclusion, Mr. Carter refers to the patents to Bell and Tainter and to Tainter before referred to, which were granted prior to the application for the patent under consideration, as well as to other patents of Mr. Edison, the applications for which were filed subsequent thereto, in all of which patents reference is made to the formation of records in the first instance by a cutting or scraping recording device. These patents do not, however, comprise the entire art, nor do they correctly comprehend the phonographic art as it existed prior to and contemporaneously with the making of the present invention. In fact, as I shall show, it was well recognized, prior to the date of the application for the patent under consideration, that the waxlike qualities which a satisfactory phonographic recording material should have, relate essentially to its *physical* structure—the amorphous and smooth condition of its surface—more than to anything else. Thus, in the patent to Bell and Tainter, which stands at the very

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foundation of the modern phonographic art, the invention is stated as consisting in "engraving or cutting the record in a *waxy* or *amorphous* and slightly cohesive substance." Here the inventors use the word "amorphous" as synonymous with "waxy," and emphasize the fact that the essentially waxy character which the record should possess is an amorphous form --i. e., free from fibrous or cellular properties which would affect the reproduction. It is interesting to

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note, also, that in this patent to Bell and Tainter the expression "wax or waxlike material" occurs in many of the claims. Viewing this Bell and Tainter patent, therefore, as it properly may be regarded, as indicating the exact meaning of the expression "wax or waxlike material," as understood by those skilled in the art at the date of Edison's application, it is clear to my mind that by that expression is meant any "waxy or amorphous and slightly cohesive substance" suitable for use for making phonographic records. Celluloid

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is of course amorphous, and can be dissolved in a solvent to a slimy consistency. It is slightly cohesive in the sense used by Bell and Tainter, because its particles are capable of being readily displaced to assume the form of the phonographic record. More than this, Mr. Carter admits (x-Q. 106) that if the celluloid record be softened during the operation of recording directly upon it, it even becomes "waxlike in the respect that it can be cut," and in this respect complies with the extremely narrow and unwarranted

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definition which he applies to the terms of the claims. Furthermore, I understand it to be a fact that a record can be satisfactorily formed by an ordinary recording device on a celluloid record without any previous treatment of its surface, and, this being so, celluloid in its normal condition complies with the requirements of Mr. Carter's narrow definition of "waxlike material."

The Bell and Tainter patent was considered by Judge SHIPMAN in *American Graphophone Co. vs. Leeds et al.* (87 Fed. Rep., 873), in which case the argument was made that the Edison "metallic soap record" was

not composed of "wax or a waxlike material." Judge SHIPMAN said :

"The material which is described in the patent is a waxy or amorphous or slightly cohesive substance which can readily be cut and can readily be removed in chips or shavings. The metallic soap blank is substantially a mixture of stearic acid or stearin and ozocerite, paraffin and ceresin, and is a cohesive waxlike material without fiber. Mr. Edison, in two patents Nos. 484,583 and 484,584, in speaking of the phonogram blanks in use in 1892, says : 'The surface is ordinarily of wax or a stearate or hard metallic soap or other waxlike material or composition.' The criticism in regard to the material is not well founded."

Here it will be noted that Judge SHIPMAN emphasizes the importance of the physical structure rather than the chemical composition of the record or blank, by characterizing a waxlike material as being "*without fiber*." This is exactly what I mean by "amorphous."

However, at the date of the patent in suit, and with due respect to Mr. Carter's opinion to the contrary, Mr. Edison did not alone contemplate the making of records of waxlike material "readily capable (as Mr. Carter expresses it) of being engraved by the cutting style or recorder," since in his patent No. 382,419, issued simultaneously with the patent under consideration, he describes a process of making duplicate phonographic records "preferably of a wax composition *which is too hard to be practically indented directly in the phonograph*." Not only, therefore, is Mr. Carter incorrect when he states that at the date of the patent in question a *waxlike* material must be one "readily capable of being engraved," but the fact seems to be that Mr. Edison contemplated using a *wax composition* at that time which did not possess that capacity.

More than this, the prior art shows that at the date of the patent in suit, *celluloid* was recognized by



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workers in this field as a suitable waxlike material for use in the manufacture of phonogram blanks. Thus in the patent to Herrington, No. 397,856, dated February 12, 1889, the application for which was filed June 18th, 1887 (more than six months prior to the application for the Edison patent under consideration), a method of recording speech on various substances referred to therein is described. The patent says:

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"Suitable materials for the purpose are *celluloid*, glue, *wax*, molasses, pitch, asphalt, or various glutinous or resinous substances, or two or more of such substances, in combination. A compound which I have found specially advantageous is one of *celluloid* mixed with a smaller quantity of molasses and *beeswax*, the celluloid and beeswax being dissolved with ether or other suitable solvents before mixing. This mixture I then spread evenly on a strip of paper or other suitable surface and allow it to dry hard and then finish it with as smooth surface as possible."

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Here it will be noted that celluloid and wax are included in the same category of "suitable materials" for the manufacture of phonographic records and blanks.

In Herrington patents Nos. 399,264 and 399,265, of March 12, 1889, reference is again made to "*wax*, resin, pitch, *celluloid*, glue, *rubber*, or their compound or equivalent."

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In Herrington patent No. 464,476, dated December 1, 1891, the application for which was filed September 11th, 1886 (less than three months after the earliest Bell and Taintor case), suitable materials for making phonographic records include "boiled tar, pitch resin, *asphalt*, *dental wax*, or similar hard substances or compounds which become plastic when heated."

Asphalt, which is admittedly a very hard material with a relatively high boiling point, is referred to by Mr. Edison in his patent No. 488,191, dated December

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20th, 1892 (application filed January 19th, 1889), in which he refers to compositions of asphalt and Japan wax or pitch in varying proportions in order to obtain records differing in friability. The claims of this patent allude to "wax or waxlike material," indicating therefore that Edison regarded asphalt as waxlike for the purposes of this art.

From what we have said, I think it follows that Mr. Carter, in asserting that the expression "wax or waxlike material" as used by Edison in the patent in suit now under consideration intended to include only those materials which are "readily capable of being engraved by the cutting style or recorder," was actuated more by a desire to so contract the scope of the claims as not to include defendants' celluloid record than by an effort to ascertain the true bearing of the patent with reference to contemporaneous facts. If that had not been his purpose he would not, in my opinion, have adopted so indefensible a position. On the other hand, if he had carefully examined the literature bearing on the question, he would, I believe, have reached the same conclusion as myself—namely, that the expression "waxlike," as used by Edison in the patent under consideration, includes all materials having that waxlike quality of surface and physical structure as fits them for use in this special field. He would have found, by reference to the earliest patent to Bell and Tainter, that "waxlike" is used practically as a synonym for "amorphous." He would also have discovered, by reference to the patents to Herrington, some of which are very much earlier in date than the application for the patent under consideration, that celluloid and wax are used as equivalent materials. The fact would also have been brought to light that Mr. Edison himself has referred to asphalt as "waxlike." And, finally, he would have been brought to the conclusion that wax itself had been described as being incapable of being readily cut, so as to thereby be devoid of the very quality which he believes should be possessed by any

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substance included in the broad category of a waxlike material. I repeat, that if Mr. Carter had been advised of these facts, I do not think he would have denied the substantial identity of defendants' records with those of the patent under consideration, nor would he have denied that those records, in view of all the circumstances of the case and of the common knowledge in the art as it existed at the date of the patent in suit were essentially waxlike in character.

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As I have pointed out, Mr. Carter under cross-examination (x-Q. 128) was unable to state what qualities of wax might be omitted from a material without excluding it from his definition of "waxlike," and this lack of certainty seems to be characteristic of the deposition as a whole. It appears (x-Q. 122) that defendants' records are not made of pure celluloid, but are formed of a celluloid composition. Herrington, in his patent No. 397,856, describes a phonogram composition formed of celluloid and wax, and Edison in his patent

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No. 488,191 describes a phonogram composition composed of asphalt and wax or pitch in varying proportions. Mr. Carter does not entertain any doubt also—

"as to the possibility of changing the composition of the Edison soap records to increase their toughness and reduce their friability" (x-Q. 121).

Bearing these facts in mind, reference may be made to Mr. Carter's cross-examination:

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"x-Q. 120. Please assume one of the Edison soap records made of the same composition, to which is added gradually increasing proportions of an ingredient by which the toughness of the resulting record will be increased and its friability reduced. When would such record cease to become waxlike?

"A. I don't know.

"x-Q. 123. Assume that in the manufacture of a celluloid composition for use as a phonographic record or blank, we add an ingredient

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to the composition in gradually increasing proportions, so as to gradually reduce the toughness of the resulting record and gradually increase the friability thereof. Can you state when such records will cease to be celluloidlike?

"A. No.

"x-Q. 124. If in the first case we gradually increase the toughness and reduce the friability of an Edison soap blank, we gradually approximate towards celluloid in this respect; do we not? 290

"A. Yes.

"x-Q. 125. And if in reducing the toughness and increasing the friability of celluloid blanks in the second case we gradually approach the qualities of the soap records in these respects; do we not?

"A. Yes.

"x-Q. 126. And you are unable, as I understand it, to draw any definite line in the assumed case so that waxlike blanks will fall on one side and celluloidlike blanks will fall on the other side? 291

"A. That is correct; I am unable to draw any such line."

Mr. Carter was quite right in making this admission. There is no distinctive and characteristic difference between celluloid and wax so far as those materials are useful for the manufacture of phonographic records or blanks. One is plainly the equivalent of the other, and at the date of the patent under consideration the two materials were so regarded and were associated with each other for this purpose. One was as common as the other. The early inventors also recognized that compositions of celluloid and wax could be used; so that the two materials were not only employed interchangeably, but were utilized together. Hence no clear line of demarcation existed 292



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between them, and for the purposes of the art one was the same as the other.

In view of the facts to which I have referred, showing that Mr. Carter's opinion seems to be based upon an incorrect and insufficient knowledge of the true situation, it is unnecessary for me to consider in detail the arguments which he advances in distinguishing defendants' celluloid records from the modern soap records now in use. I am prepared to admit that cel-

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luloid records are tougher than wax or soap records, and soften only under relatively high temperatures; also that wax or soap records are better adapted to be directly operated upon by a phonographic recorder than celluloid records; and, finally, that records on celluloid can best be secured by a duplicating operation from a suitable *bas relief* negative. These admissions do not, however, affect the substantial identity of the two records in the sense of the patent in suit, or in the light of the common knowledge in the art at

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the date of the application therefor. At that time, materials of varying degrees of toughness and friability were well known, ranging from beeswax on the one hand to celluloid, rubber and asphalt on the other. The meeting point was also unimportant and had varied from that of beeswax, which softens at a temperature below blood-heat, to asphalt and celluloid, both of which become soft at much higher temperatures. The recording directly on the material was, furthermore, not the only known way of securing phonograph records, because Edison, in his patent No. 382,419 dated

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May 8, 1888, (contemporaneously with the patent in suit under discussion), describes a process of making *duplicate* records by a knurling operation "preferably of a wax composition, which is too hard to be practically indented directly in the phonograph." If, therefore, at the date of the patent in suit, the use of celluloid and celluloid compositions for the manufacture of phonograph records and blanks was unknown, the fact that among those skilled in the art, the employment of materials differing widely in the very properties in



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which Mr. Carter distinguishes celluloid from the ordinary soap records and blanks, had been generally and commonly suggested, destroys the foundation on which his opinion is based. In other words, leaving celluloid entirely out of consideration, the prior art discloses the common employment of materials varying as much from wax as commonly understood in the particulars to which Mr. Carter calls attention, as does celluloid. Yet the fact is that all of the suggested prior materials —beeswax, paraffin, hard wax compositions, glue, molasses, pitch, asphalt, glutinous and resinous substances, resin, rubber, ozocerite, boiled tar, dental wax, Japan wax or compositions thereof, as well as celluloid possess that desirable warlike quality of surface and physical structure that fits each for effective use in this field. When, however, we recall the fact that celluloid *was* commonly known as a suitable material for making phonograph records and blanks at the date of the patent in suit, we see that whatever distinctions may be drawn between that material and the particular waxlike substance which Mr. Edison now uses are only the differences which skilled persons have all along recognized might exist between suitable materials for the purpose, without, however, distinguishing those substances in the broad properties which they possess in common, and by reason of which they become available for satisfactory use.

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In view of these considerations I repeat the opinion which I formerly expressed, that defendants' celluloid blanks are made wholly of waxlike material and realize all the advantages of the invention of the patent under consideration. I not only reaffirm the opinion formerly expressed by me, that defendants' celluloid records are the equivalent of the records of the patent, but I believe that if Mr. Carter had been fully advised of the exact facts connected with the early development of this art he would have reached a similar conclusion.

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7 Q. Please consider so much of Mr. Carter's deposition as relates to Edison patent No. 414,761 in connection with the several exhibits referred to by him,



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and state whether or not you agree with Mr. Carter's conclusions as to this patent, and, if not, then give your reasons why you entertain a different opinion?

A. I do not agree with Mr. Carter. In considering this patent he expresses the opinion that if—

“limited to a wax or waxlike record cylinder cast in a mold and with a series of ribs or spiral projecting turns provided at intervals along the interior bore or surface of the cylinder,”

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it covers a patentable invention. In that case, however, he admits that the first and second claims could not be distinguished from each other (x-Q. 148). According to his view, if the claims are given a broader construction, then they cover—

“nothing more than the ordinary and universal practice common for generations, if not for centuries, of cutting or boring out the interiors of cylinders, drums, and hubs generally, for the purpose of reducing the machine work necessary to ream or cut them out to fit the mandrel or shaft upon which they are designed to be placed, and for the purpose of saving weight and material.”

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As disclosing this practice, Mr. Carter relies on Defendants' Exhibit L, showing a sectional view of an Edison electric generator. Concerning this alleged anticipation, he makes the significant admission (x-Q. 152) that he does not know “whether a tight, frictional engagement is contemplated or not” between the shaft and the parts held thereon—

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“but, inasmuch as it is absolutely essential that there shall be no relative rotation between them, the frictional engagement is not alone depended upon, but a key is also employed to positively prohibit such rotation.”

It is also a fact concerning this exhibit, which Mr. Carter admits (x-Q. 153), that the shaft is not tapered.

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In view of the facts that the only reference which Mr. Carter has found is not even remotely suggestive of the phonographic art, that the shaft on which the rotating element is turned is not tapered, as is the case with the mandrel of a phonograph; and, finally, that the turning of the rotating part is effected, not by friction, but by means of an ordinary key, I do not agree with Mr. Carter that defendants' construction

"resembles the device of that patent (under consideration), in so far as it resembles it at all, only in and to the extent that both devices adopt and make use of the same obvious and well-known expedient generally adopted under similar circumstances and in similar situations throughout the entire realm of mechanic arts." 306

This is not so. The defendants' celluloid record resembles the record of the patent, in the first place, in being molded. Mr. Carter states that the molding of defendants' celluloid records 307 differs from that of the patent, "which clearly contemplated the casting of the melted material in a mold" (x-Q. 155), although he says that there is nothing in the prior art necessitating such a limitation. In the next place, defendants' celluloid records, in common with those of the patent in question, are cut away only to the extent of leaving sufficient material for engagement with the tapered mandrel as to obtain the necessary frictional grip between the record and mandrel as to properly rotate the 308 former. And finally, the records of the patent in question, in common with defendants' celluloid records, are so cut away as to form ribs or flanges of different diameters, to be thereby properly received upon the tapered mandrel of the standard phonograph. None of these features which characterize the Edison invention have been disclosed to be old, and they are certainly not disclosed, on Mr. Carter's own admission, in the only exhibit to which he has referred, namely, Exhibit L. Mr. Carter practically concedes the entire



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novelty of the patented invention in his cross-examination :

" x-Q. 149. Do you know of any instance in the prior art where a phonogram record or blank has been provided on its bore with cutaway portions forming ribs for supporting the record ?

" A. No.

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" x-Q. 150. Do you know of any instance in the prior art where a phonogram record or blank has been provided on its bore with a plurality of ribs or flanges for supporting the record ?

" A. No.

" x-Q. 151. Would you include defendants' records in the latter definition ?

" A. Yes."

It seems to me, therefore, that Mr. Carter has fallen far short in his effort either to show anticipation of the patented invention or non-infringement thereof.

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He specifically admits, in fact, that the patent is capable of a construction which clearly includes defendants' record, and that is the construction which its claims must obviously have. On the question of anticipation, he has, I think, clearly failed, since obviously, his reference to dynamo construction, in which the conditions are entirely dissimilar from the phonographic art, is neither analogous nor pertinent.

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In view of these considerations, I reaffirm the opinion which I have already expressed, to the effect that defendants' records are clear and exact mechanical equivalents of the constructions set forth in the first and third claims of the patent under consideration.

Counsel for complainants offers in evidence copies of the patents referred to by the witness, as follows :

Patent to Tainter, No. 380,535, dated April 3, 1888, and the same is marked "Complainants' Exhibit Tainter Patent No. 380,535."

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Patent to Edison, No. 382,419, dated May 8, 1888, and the same is marked "Complainants' Exhibit Edison Patent No. 382,419."

Patent to Herrington, No. 397,856, dated February 12, 1889, and the same is marked "Complainants' Exhibit Herrington Patent No. 397,856."

Patent to Herrington, No. 399,264, dated March 12, 1889, and the same is marked, "Complainants' Exhibit Herrington Patent No. 399,264." 314

Patent to Herrington, No. 399,265, dated March 12, 1889, and the same is marked "Complainants' Exhibit Herrington Patent No. 399,265."

Patent to Herrington, No. 464,476, dated December 1, 1891, and the same is marked "Complainants' Exhibit Herrington Patent No. 464,476."

Patent to Edison, No. 488,191, dated December 20, 1892, and the same is marked "Complainants' Exhibit Edison Patent No. 488,191." 315

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Notice.

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UNITED STATES CIRCUIT COURT,  
NORTHERN DISTRICT OF ILLINOIS,  
NORTHERN DIVISION.

318

NATIONAL PHONOGRAPH COMPANY,  
Complainant,

vs.

LAMBERT COMPANY and THOMAS B.  
LAMBERT,  
Defendants.

In Equity.

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EDISON PHONOGRAPH COMPANY,  
Complainant,

vs.

LAMBERT COMPANY and THOMAS B.  
LAMBERT,  
Defendants.

In Equity.

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THOMAS F. SHERIDAN, Esq.,  
Solicitor for Defendants, Marquette Building  
Chicago, Ill. :

Please take notice that the complainants herein will take the testimony of Thomas A. Edison, of Llewellyn Park, New Jersey, who resides more than one hundred (100) miles from the place of trial herein, and more than one hundred (100) miles from any place at which a Circuit Court of the United States for the Northern District of Illinois, Northern Division, is appointed to be held by law, at final hearing, for use on behalf of the complainants, before John F. Randolph, Esq., a

Notice.

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notary public, in and for the State of New Jersey, who is not of counsel nor interested in this cause, at the Edison Laboratory, West Orange, New Jersey, on the 13th day of October, 1902, at 10:30 o'clock A. M., and thereafter from day to day as the taking of the deposition may be adjourned; and such testimony will be so taken in accordance with the provisions of Sections 863, 864 and 865 of the Revised Statutes of the United States and the Equity Rules.

Dated October 3, 1902.

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ISHAM, LINCOLN & BEALE,  
Solicitors for Complainants.

Due and timely service of the above notice is hereby admitted this 5th day of October, 1902.

THOMAS F. SHERIDAN,  
Solicitor for Defendants.

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T. A. Edison.

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## UNITED STATES CIRCUIT COURT.

NORTHERN DISTRICT OF ILLINOIS.

326

EDISON PHONOGRAPH COMPANY,  
Complainant,

vs.

LAMBERT COMPANY and THOMAS B.  
LAMBERT,  
Defendants.

In Equity.

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NATIONAL PHONOGRAPH COMPANY,  
Complainant,

vs.

LAMBERT COMPANY and THOMAS B.  
LAMBERT,  
Defendants.

In Equity.

WEST ORANGE, NEW JERSEY, October 13th, 1902.

Met pursuant to notice.

Present—RICHARD N. DYER, Esq., for complainants ;  
328 THOMAS F. SHERIDAN, Esq., for defendants.

THOMAS A. EDISON, a witness called on behalf of the complainants in the above-entitled suits, having been first duly sworn, deposes and says in answer to interrogatories propounded to him by Mr. Dyer as follows :

1 Q. You are the inventor named in the three patents in suit, numbered 382,418, 382,462 and 414,761, are you not ?

A. I am.

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2 Q. Have these inventions been utilized commercially, and if so, to what extent?

A. They have been utilized to a very great extent commercially. From the time that the first commercial phonograph was put on the market to the present time, there have been upwards of two hundred thousand phonographs sold to the public in all parts of the world, all of which have employed the inventions of the patents in suit. Most of these phonographs have been sold by the National Phonograph Company, and also by another company who sell the phonograph under the name of the "Graphophone," which I license under my patents. In fact, all commercial phonographs which have been sold employ these inventions. 330

3 Q. What relation did the inventions of the patents in suit bear to the development of the commercial phonograph?

A. The inventions in the patents in suit are one of several which made the phonograph commercially practical. Previous to 1889 a large number of attempts had been made to devise a phonograph which could be handled by inexperienced persons, so that a machine shipped to any part of the world could be worked by any person without the necessity of having an expert to show them how to manipulate it, but just from simple printed instructions. In 1889, by a number of small inventions, this object was accomplished, and from that time the phonograph in the hands of the public worked successfully and was commercial. One of the earlier forms of phonographs was put out by the Graphophone Company, but on account of the complication of the devices used it was found not to be commercial, and all the machines put out were withdrawn from the market. The Graphophone Company then took a license under our patents, and have since put out the phonograph in the same form as is now universal, employing the inventions in this litigation. 331 332

The devices which made the phonograph commercial when used by inexperts were very simple in



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character, but were enormously important in accomplishing the object. These inventions were the dispensing with the use of mechanism to hold the cylinder in position on the phonograph, and the substitution of the simple device of a tapering mandrel and tapering cylinder. Another invention which helped to make it practical was the use of a floating weight upon which the recorder and reproducing points were placed. It was found almost impossible to get

334 the cylinders to run true, and therefore the floating weight with its recording point permitted the use of cylinders which were not accurately true when rotated. The third device which helped to make it commercial was the use of a cylindrical recording and reproducing point of hard material, like sapphire. It is almost wholly due to these three devices that the phonograph was made commercial.

It was found essential that the blank should be made wholly of the same material or two materials both having the same coefficient of expansion. A large number of attempts were made to form a compound cylinder with wax for the outer recording material, but on account of not being able to obtain a cylinder the inner portion of which had the same coefficient of expansion as the outer, the compound cylinder had to be abandoned, on account of the large amount of breakage due to shipment and changes of temperature. Finally a cylinder made entirely of the same material was adopted, and this is shown particularly in patent No.

336 414,761. This blank being of the same material throughout would withstand any change in temperature. At first the blank was reamed out, tapered, and the inner part was solid, but it was found after a time that a continuous surface did not hold as well on the tapering mandrel, and that wax chips and dirt would get inside and tend to break the cylinder when it was forced on, and also make it run out of true, and therefore an inner rib was cast with the cylinder and this was tapered to fit the mandrel of the phonograph. This permitted of obtaining the outer surface of the cylin-

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der more true when the phonograph was revolved, and to also hold the cylinder with sufficient force so that in the act of turning off the cylinder to make a new record it would not be forced along the taper and loosened. In fact, by this simple device all mechanism for securing the cylinder was dispensed with, and the most inexperienced person could at once put the cylinders on and off the phonograph without any instructions or any skill required, and this form with these ribs has been universal since their introduction, and many millions have been sold. They are employed also by the Graphophone Company and all foreign makers of phonograph cylinders. 338

## CROSS-EXAMINATION BY MR. SHERIDAN :

4 x-Q. It was old long before you made this invention to use tapered cylinders in other arts, was it not, Mr. Edison?

A. I don't know. 339

5 x-Q. Then you thought you had made a tapered cylinder for the first time in mechanics, a cylinder with a tapered bore ; did you?

A. I don't know that. I know that the invention solved the problem in a simple manner—what we were after.

6 x-Q. Didn't you know that in the art of mechanics generally, tapered spindles were old ?

A. I don't know whether I did or not. I don't remember. 340

7 x-Q. Don't you know that they have used in watch lathes tapered bearing for a long time, tapered bushings ?

A. I don't recall to mind any just now. If they have, it is a matter of record.

8 x-Q. Then you thought that you were the inventor of a tapered mandrel and a tapered cylinder in the arts generally ?

A. I thought I was the inventor of a way of holding a phonograph cylinder on a tapered mandrel.



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9 x-Q. And you never knew of any other tapered cylinder, of any other description, ever being held on a tapered mandrel?

A. I don't call them to mind now. I suppose there have been tapering mandrels with things put on them and held there, so that they could be turned off, but I don't remember any working by mere friction.

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10 x-Q. In this patent No. 382,462, the subject matter was intended to overcome the difficulty that you experienced in having phonogram blanks made of wax and another material inside having a different coefficient of expansion, was it not?

A. Yes.

11 x-Q. The objection was not to the inner material, but the objectionable feature you found was the wax would crack in shipping or due to changes in temperature?

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A. The difference of expansion between the inner and the outer surface caused it to crack. Therefore I made it all of one material and got rid of this objection.

12 x-Q. Now supposing that the outer surface, instead of being wax, were made of hard rubber or a material like that, would it have cracked then due to the difference of expansion between it and the inner material?

A. That would depend upon the kind of inner material. If there was a difference in the coefficient of expansion it might have cracked.

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13 x-Q. But you never found any other material that cracked besides wax, did you, or a wax-like material?

A. If you use the wax-like material very soft it won't crack. In fact, in the early days the Graphophone Company used a paper cylinder on which there was wax on the outside, but the wax was so soft that under the varying temperatures it would give and not crack. But we desired to use a wax that was very hard, as a very hard wax makes a better record and stands up; when the reproducing point is passed over it, it is not smoothed down as it would be with a very soft wax.

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14 x-Q. How thick was your coating of hard wax?

A. Well, we had them in various thicknesses. Sometimes we had them five thousandths, sometimes twenty thousandths, sometimes even thicker.

15 x-Q. How thick could you go on the outer coating? What was the thickest you ever used of wax with the inner tube of different material?

A. I think the thickest wax coating we have used was about thirty thousandths of an inch.

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16 x-Q. And when you abandoned this inner tube or sustaining material you also made the wax cylinder not only homogeneous but a great deal thicker, did you not?

A. Yes, sir; so that it would have strength of its own and didn't require the backing.

17 x-Q. Do you recollect how thick you made it when you first abandoned the different material?

A. My impression is that it was about three-sixteenths thick outside of the ribs.

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18 x-Q. Did your first phonograms made entirely of wax contain ribs?

A. At first they didn't have any ribs, but they would not hold on well.

19 x-Q. How thick were the materials that didn't have any ribs?

A. My impression is they were about a quarter of an inch.

20 x-Q. And the reason they didn't hold well without ribs was that the dust would accumulate between the two tapers, the taper of the bore and the taper of the spindle?

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A. Yes; for that reason and for the reason they didn't have the elasticity between the ribs.

21 x-Q. What do you mean by "elasticity between the ribs"?

A. The wax has a certain degree of elasticity, and in forcing them on the mandrel this elasticity was used to a certain extent.

22 x-Q. But the principal reason, however, was to allow space in which dirt in chips might accumulate that wouldn't throw them out of true; is that not so?



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A. That was one of the reasons, and another was to get the elasticity and also to permit ease of reaming in forming the cylinder, so it was cheaper.

23 x-Q. It is not as hard to ream a cylinder made with internal ribs as one that is solid?

A. No, not so hard.

24 x-Q. There is less material to ream?

A. Yes, sir; you can ream it truer.

25 x-Q. Did you ever make any celluloid records?

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A. I think we have.

26 x-Q. How long ago?

A. Six or seven years ago.

27 x-Q. By the same process as you make these blanks described in patent No. 414,761?

A. No, sir; by another process.

28 x-Q. Can you make a celluloid record by the process described in this patent?

A. I never tried.

29 x-Q. Do you think you could?

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A. I don't know.

Signature and certificate waived.

Complainants' counsel gives notice that the proof for the complainants is closed, and that he will put the cases on the calendar for hearing as soon as permitted by the rules of the Court.

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[21153]

*Notice.*

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CIRCUIT COURT OF THE UNITED STATES, NORTHERN  
DISTRICT OF ILLINOIS, NORTHERN DIVISION.

Edison Phonograph Company,	} In Equity.
<i>Complainant,</i>	
<i>vs.</i>	
Lambert Company and Thomas	
B. Lambert,	} <i>Defendants.</i>

TO RICHARD N. DYER,  
Of Counsel for Complainant.

Please take notice that on Monday, the 24th day of February, 1902, at 10 o'clock A. M., I shall proceed to take the testimony of Henry W. Carter, of Chicago, Illinois, on behalf of the defendants in the above entitled cause before Annie C. Courtenay, a notary public in and for the County of Cook and State of Illinois, at my offices, Suite 531-32 Marquette Building, Chicago, Illinois, and thereafter from day to day until completed. You are invited to attend and cross-examine, if you so desire.

THOMAS F. SHERIDAN,  
Solicitor for Defendants.

CHICAGO, February 18, 1902.

Service of the above notice acknowledged and copy thereof received this 20th day of February, 1902.

RICHARD N. DYER,  
For Complainant.



CIRCUIT COURT OF THE UNITED STATES, NORTHERN  
DISTRICT OF ILLINOIS.

Edison Phonograph Company, <i>Complainant,</i>	} In Equity.
<i>vs.</i>	
Lambert Company and Thomas B. Lambert,	
<i>Defendants.</i>	

National Phonograph Company, <i>Complainant,</i>	} In Equity.
<i>vs.</i>	
Lambert Company and Thomas B. Lambert,	
<i>Defendants.</i>	

Testimony taken on the part of defendants before Annie C. Courtenay, a notary public, and acting as Special Examiner by consent, at the office of Thomas F. Sheridan, Esq., No. 204 Dearborn street, Chicago, Illinois, Monday, February 24, 1902.

Present: Thomas F. Sheridan, Esq., for defendants.

Met pursuant to notice and adjourned until Thursday, March 6, 1902, at 10 o'clock A. M., at same place.

March 6, 1902. Met pursuant to adjournment. Present: Richard N. Dyer, Esq., for complainant; Thomas F. Sheridan, Esq., for defendants.

It is stipulated between counsel that testimony may be taken by either complainant or defendants in both cases jointly and simultaneously.

*Deposition of Henry W. Carter.*

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HENRY W. CARTER, a witness produced, sworn and examined on the part of defendants, deposes and testifies as follows in answer to questions by Mr. Sheridan:

Q. 1. State your name, age, residence and occupation.

A. Henry W. Carter; thirty-five years; Chicago, Illinois; I am a mechanical expert.

Q. 2. What experience have you had which would qualify you to testify as an expert witness in patent causes?

A. For the past eighteen years I have been continuously engaged in mechanical studies and pursuits, and for the past twelve years in such studies and pursuits in relation to matters pertaining to patents for inventions. My mechanical training began in the repair shop of the Washburn Manufacturing Company, Worcester, Mass., where I served an apprenticeship preliminary to entering the mechanical engineering course at the Polytechnic Institute in that city. I received my degree there in 1886, and for three years thereafter worked as a practical machinist and draftsman with various machine companies. I then entered the examining corps of the United States Patent Office, where I was for several years continuously engaged in examining applications for patents and in passing upon their claims to determine their patentability in view of the prior art. Later I resigned to enter practice as a solicitor of patents and mechanical expert in all matters pertaining thereto, and am still engaged in such practice and have repeatedly testified as an expert witness in patent causes pending before the United States courts and the courts of this state. I have prepared many hundreds of applications for patents on all classes of patentable de-



vices, and am thoroughly conversant with patent specifications and drawings and with machinery in general. During my shop experience I learned the machinist's trade and was accustomed to operate all ordinary machine tools, and became familiar with the general run of mechanical methods and processes. During a portion of the time that I was employed in the Patent Office I was obliged to make daily use of a graphophone in the ordinary course of my duties there, all correspondence emanating from that division being dictated to such machine, and in this way I came in contact and became familiar with phonographic devices and phonograms, to which I understand this controversy relates, and I have been accustomed to use and observe such machines and devices occasionally ever since that time. I am a member of the American Society of Mechanical Engineers and of the Western Society of Engineers and have been for many years past.

Q. 3. Have you examined each of the patents sued on in this cause, particularly the claims thereof, and do you understand the same?

A. Yes.

Q. 4. Have you read the deposition of Frank L. Dyer, the expert for complainant in these cases?

A. Yes.

Q. 5. Please take up and consider the three Edison patents in suit in connection with the celluloid phonographic record, "Complainant's Exhibit Defendants' Record," and state whether or not, in your opinion, said record embodies the alleged invention described and illustrated in Edison patent No. 382,418, and covered by the first and second claims thereof? Please state the matter in your own way, giving your reasons fully for any opinions you may express and making such reference to the

*Deposition of Henry W. Carter.*

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prior art and the art in general as in your judgment you think proper.

A. The term "alleged invention" is well used in this connection, for the only invention I have been able to discover in connection with this Edison patent No. 382,418 is the allegation which dubs it such. In my entire experience I do not remember to have ever had brought to my attention any letters patent more wholly lacking in any disclosure calling for the slightest exercise of the inventive faculty in its production. Stripped of the terminology which particularly relates to the phonographic art, the idea of novelty which this patent purports to set forth is the providing of a cylinder with a taper bore, so that when slipped upon a correspondingly tapered mandrel or arbor it will fit tightly and concentrically thereon. It seems almost incredible that in these modern days a claim for patentable novelty could be based upon this tapered cylindrical construction, which is as old as the turning lathe and as common as the ordinary dovetail joint. Indeed, I doubt if it would be possible to mention any mechanical construction in turned or circular work, and especially in rotating devices and machinery, more universally employed. And the reason for this will be more readily apparent when it is considered that this taper construction is nothing more or less than a circular embodiment of the wedge, which all will recognize as one of the fundamental mechanical elements. If one wishes to fit a plug tightly in an aperture, he makes them wedge shaped. If the parts are round the wedge is called a taper, and if the outer or inclosing part is turned off concentrically with the axis of its socket, it is a cylinder having a concentric taper bore; and this cylinder is then in every essential the claimed invention of this Edison patent No. 382,418, in



so far as that patent is alleged to contain any feature of novelty. Such a cylinder, if mounted in the bearings of a lathe-head, becomes its live spindle, and its concentric taper socket receives and serves to concentrically rotate the lathe-center, which is made correspondingly tapered to fit tightly thereon. Or this lathe-center may be replaced by a plug arbor, which is not only tapered to fit the socket in the spindle, but is oppositely tapered at its projecting end so that it in turn serves as a mandrel upon which other cylinders having taper sockets to fit may be frictionally secured and concentrically rotated, as in the case of the smaller sizes of the ordinary centering lathe-chuck. The tail spindle of an ordinary lathe is another such tapered-bored cylinder, and differs only from the live spindle in being mounted to slide longitudinally instead of rotating. Fitting into the taper-bored concentric socket of this tail spindle is a tapered dead center, and this dead center is, by reason of the taper fit between it and the tail spindle, held concentrically and friction-tight within the latter. Then in turning up such cylindric or other pieces as have holes in them, the pieces are slipped over a taper mandrel and driven upon the mandrel until they are so tightly held as to be rotated thereby when the mandrel is rotated. The mandrel has conical depressions formed centrally in its ends, and these depressions or centers are made to be engaged by the centers of the live and tail spindle of the lathe, and the mandrel being then additionally connected with the live spindle by a driving dog or like contrivance is rotated concentrically of the lathe spindles, carrying with it the piece to be turned. Ordinarily this piece is not bored out on a taper, but when driven upon the taper mandrel necessarily assumes a taper form on its interior, by reason of the compression of the

material toward the larger end of the taper, but in any case the same taper fit exists between the piece to be turned and the taper mandrel, as between the phonogram blank and the cylinder or mandrel of the phonograph, and the result obtained is precisely the same in both cases, *i. e.*, the securing of the cylindric part to be turned detachably and frictionally upon the taper mandrel, so that it will rotate concentrically therewith. Just so the securing of the live center frictionally within the taper socket of the live spindle accomplishes exactly the same result of causing the parts to rotate concentrically, and the fact that it is the outer cylindric part, instead of the inner conical part which acts as the support and is mounted to rotate in bearings, affects not in the slightest degree the object, nature or result of the connection between them. While in the case of the taper plug arbor and the taper bored chuck, which is supported by such arbor, not only the object, nature and result of the connection are precisely the same, but the connection itself is precisely the same in every particular. That is to say, the tapered projecting end of the plug arbor is a rotating mandrel corresponding exactly with the supporting mandrel or cylinder of the phonograph, while the chuck which fits upon the arbor is a cylinder having a bore tapered throughout its length and made concentric with its outer surface, so that when the chuck is slipped over the mandrel or arbor it will bind upon the latter and retain its place by friction, and will be centered and rotated concentrically thereby.

The matters thus referred to are so familiar to mechanics everywhere that it seems almost superfluous to illustrate them. I would, however, refer for this purpose to the work by Joshua Rose, M. E., known as "Modern Machine-Shop Practice," published in 1887 by Charles Scribners Sons, New York, and copyrighted that year.



The general construction of an ordinary foot-lathe is shown in Fig. 480 of page 130 of that book. A sectional view of the head-stock of an ordinary engine lathe is shown in Fig. 494 of page 134, in which S is the live spindle that is mounted to rotate in bearings B and B', while T is the tapered live center which fits within a correspondingly tapered concentric socket in the end of the spindle S. A similar view of the tail stock of an engine lathe is shown in Fig. 497 of page 136, in which G is the cylindric tail spindle and J the tapered dead center which fits within a concentric tapered socket in such spindle. A tapered madrel supported between the lathe centers is shown in Fig. 777 of page 227, together with a cylindric piece of work to be turned, which is designated W, and which is assumed to have been forced tightly upon the tapered mandrel M so that it will rotate when the mandrel rotates. A centering chuck adapted to be mounted upon a plug arbor and bored out upon a taper to fit concentrically upon the tapered end of such plug arbor is shown in Figs. 819 and 820 of page 235 of this work, and while the plug arbor itself is not shown, it will be understood to be of similar construction to that illustrated Fig. 795 of page 229, except that ordinarily the left-hand end (as shown in this Figure) of the arbor is tapered to fit in the socket of the lathe spindle, instead of being made cylindric as in the cut. The tapered bore of the chuck in Fig. 820 is contained in the driving piece H. A similar chuck having a taper fit upon a similar plug arbor, a fragment of which in this instance appears in the cut, is shown in Figs. 2624 and 2625 of Appleton's Cyclopaedia of Mechanics, Vol. II, page 251, published in 1884 by D. Appleton & Company, New York. Aside from these references, however, I can testify of my own knowledge and from my own experience that the lathe, madrel and chuck con-



*Deposition of Henry W. Carter.*

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structions which I have referred to were in actual use commonly in machine shops prior to the year 1887, and I have no doubt that they have been in use for a generation before that time. Vol. 35 of the Scientific American shows on page 210 of the issue of July 26, 1876, for example, a taper socketed chuck of the character referred to, and Vol. 36 shows on page 118 of the issue of February 24, 1877, a similar chuck mounted on a taper spindle.

It will of course be understood that prior to the alleged invention of this patent No. 382,418 phonogram blanks in all respects identical with those disclosed by the patent, except as to the single feature of the taper bore, were old and known in the art. In fact, it would have been difficult to have distinguished by mere observation the alleged improved phonogram blank from the old blank upon which it assumes to improve. The old blank had the same cylindric shape in general appearance, it had the same cylindric recording surface concentric with its bore, it had the same backing *r*, and its recording surface was made of wax or of wax-like substance mounted in the same manner upon such backing. All this is shown, for example, in the patent to Taintor No. 341,288 of May 4, 1886, filed December 4, 1885. This patent shows a cylindric mandrel for supporting the record tablet or phonogram blank, and this tablet or blank is shown and described as an elongated hollow cylinder or tube of paper or paste-board coated with a layer of a compound of beeswax and paraffine. No method is described in this patent of securing the cylindric blank on the cylinder or mandrel of the phonograph, but the description leaves it to be inferred that it is fitted closely to the cylinder so as to be held frictionally thereon, an inference which is confirmed by the patent to Taintor No. 375,579 of December



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27, 1887, filed July 7, 1887, which states on page 1, line 76-78, that "the tablets are designed to fit the holder accurately, and heretofore they have been held simply by being slipped on, being held in place by friction." The tablets here referred to, it will be noted, are the same cylindric tablets as those of the earlier Taintor patent above mentioned, and the holder is the same cylindric mandrel over which the tablets are slipped.

Considering, then, this old phonogram blank with reference to the carefully elaborated utilities which complainant's expert has found to characterize the alleged novel phonogram blank of the Edison patent No. 382,418, the old blank, when simply slid over the mandrel or phonogram cylinder, would automatically center itself so as to be truly concentric with the mandrel and would also retain its position so as to be rotated with respect to the recording and reproducing devices by friction alone. Quite irrespective of Mr. Edison's alleged invention, it was "possible to readily place the record or blank on the mandrel or phonogram cylinder of the phonograph, for the reason that all it is necessary to do is to push the record or blank over the mandrel until the former binds on the latter and retains its place by friction." The placing of the old blank upon the mandrel "effected the true centering of the record or blank with respect to the recording or reproducing devices, for the reason that when the record or blank is in engagement with the mandrel, the two will be absolutely concentric, and since the relation between the mandrel and the phonograph and its recording and reproducing devices is fixed, the record or blank when in position on the mandrel will for all portions of its surface occupy the desired relation to those devices." And finally with the old blank it was "possible for the record or blank to retain its position on the man-

drel or phonogram cylinder by friction alone," and the fact is that it was so retained by friction alone. And even with regard to what complainant's expert has termed the "further and very important advantage—that phonograph records or blanks of widely different lengths can be properly received and held on the tapered mandrel," this advantage was possessed equally by the old phonogram blank as used in the Taintor patent, and for the same reason "that the engagement between the record or blank and the mandrel is a radial and not a longitudinal engagement." In this Taintor patent it could obviously make no difference whether the phonogram blank was long or short, and the four different lengths of blank shown in Fig. 2 of this Edison patent might as well be illustrations of the old blank as of the new one.

Not only is it therefore true that the only possible feature of novelty in Edison's alleged invention lay in the taper form which was given to the bore of the cylindric blank; but it is equally and obviously true that no new result whatever in any way peculiar to phonogram blanks or to the art of reproducing speech by phonographic machines was accomplished by making the bore tapering. The action of the machine and of the record tablet, considered separately and in co-operation, was exactly the same with the new as with the old blank, and the tapering of the bore required no reorganization or re-adaption whatever, the slight change in structure involved being entirely isolated in its nature and effect from the remaining characteristic features and functions of the phonogram. As a consequence, there is absolutely no escape from the conclusion with which I commenced this answer, that in so far as this one feature of novelty is concerned, *i. e.*, the tapering of the bore of the cylinder to fit a correspondingly tapered supporting mandrel, the problem



presented, the objects to be attained, and the structural feature by which the desired result was reached, were precisely the same in the case of this cylindric phonogram blank as in the case of any other two concentric rotating parts fitted to each other upon a taper so as to be frictionally held together and rotated in the desired relation, while at the same time readily separable, as in the case of the lathe, mandrel and chuck constructions to which I have before referred. Paraphrasing complainant's eulogy of this alleged invention, for example, but substituting the taper socketed chuck before referred to for the phonogram blank in such eulogy, it will be found that his words of description and praise fit as well to the one device as to the other. Witness the following:

"The object of the invention is to produce a cylindric lathe chuck which can be readily placed upon the chuck arbor or mandrel of a lathe and will center itself, and will also be adapted to retain its place upon the chuck arbor or mandrel by friction alone. These objects are accomplished by making the cylinder or mandrel of the lathe with a slight taper and by similarly tapering the bore of the chuck, so that by sliding the latter over the mandrel or lathe arbor it will automatically center itself so as to be truly concentric to the mandrel, and will also retain its position so as to be rotated with respect to the turning tools by friction alone. This simple expedient of tapering the bore of the chuck while retaining the cylindric form of its jaw-supporting parts, and of properly modifying the lathe or turning machine so that it will be provided with a taper mandrel or arbor for receiving the chuck secured all the objects sought to be secured by this invention. That invention made it possible to readily place the chuck on the mandrel or lathe arbor for the reason that all it is necessary to do is to push the chuck over the mandrel until the former binds on the latter and retains its place by friction. The invention effected the true centering of the chuck and



chuck jaws with respect to the turning tools (or more properly the axis of rotation of the lathe spindle), for the reason that when the chuck is in engagement with the mandrel the two will be absolutely concentric, and since the relation between the mandrel of the lathe and its turning tools is fixed, the chuck when in position on the mandrel will occupy the desired relation to those devices. Finally, the invention made it possible for the chuck to retain its position on the mandrel by friction alone, for the reason that the tapered bore permits the chuck to be tightly engaged with the mandrel merely by forcing the former longitudinally until it binds in place. Thus by a very simple expedient, very important practical advantages were secured, which have, so far as I know, been utilized in all modern lathes employing centering chucks.

"A further and very important advantage arising from the construction under consideration is that chucks of widely different lengths and sizes can be properly received and held upon the tapered mandrel, for the reason that the engagement between the chuck and the mandrel is a radial and not a longitudinal engagement."

Word for word, part for part, function for function, it thus appears that the tapered bore of the old lathe chuck and the manner of its mounting are identical in structure with the tapered bore of the alleged new phonogram blank, and the manner of its mounting, while the objects attained by the construction in both cases are also absolutely identical. And this is not only true of a comparison between the lathe chuck and the phonogram blank, but will be found to be equally true of a comparison between the phonogram blank and the other taper fitted portions of the lathe and its related devices, hereinbefore referred to.

Adjourned till Friday, March 7, 1902, at 10 o'clock A. M.



March 7, 1902. Parties met pursuant to adjournment. Present as before.

Nor is this all, for it will be understood that in its general mechanical construction a phonograph is nothing in the world but a special form of turning-lathe, while the phonogram blank is merely a special kind of cylindric work which is cut in a particular manner by this special lathe, and which in order to be thus cut is placed upon a taper mandrel, just as the work to be turned in a lathe is mounted. The cutting tool in a lathe is mounted in a carriage which slides on ways parallel with the axis of the rotating mandrel, and a lead screw which rotates as the mandrel rotates serves to move the carriage and cutting tool longitudinally of the work to be turned, so that the tool cuts a spiral course along the work. If the tool is made with a wide cutting edge, it smooths the work off to a true cylindric form on its exterior, and if then this tool be replaced by a pointed tool, a spiral groove or thread will be cut in the cylindric surface of the work. This process is familiar to all mechanics under the name of "cutting a thread," and all screw threads which are not cut by the use of dies are cut in this manner. Just so the phonograph is provided with a cutting tool mounted on a carriage which slides on ways parallel with the axis of the rotating spindle, and its carriage is moved longitudinally of the work in the same manner by a screw which is geared to turn as the mandrel turns. The phonograph is also ordinarily provided with two cutting tools, one of which has a wide cutting edge and is used to turn off the phonogram blank to a true cylindric form, while the other is sharp pointed and cuts a spiral line or thread on the blank. The only essential point of difference which distinguishes the phonogram from the lathe in these

respects is that in the phonograph the sharp-pointed cutting tool is carried by a diaphragm which vibrates under sound waves, and consequently causes the spiral line or thread to be cut to constantly varying depths corresponding with the violence of the sound waves. But this difference is not in any way involved in this discussion, which does not at all relate to the action of the cutting tool, but merely to the manner of supporting the work in front of the tool, or rather to the nature of the fit between the work and the mandrel which supports it in front of the cutting tool. And as to the wide pointed or smoothing tool of the phonograph, there is no difference whatever between its mode of operation or support and that of the ordinary lathe tool, and its object is precisely the same, *i. e.*, to reduce the surface of the work to a true cylindrical form. Indeed, if a phonogram blank should be mounted in an ordinary screw-cutting lathe, either upon the ordinary taper mandrel or by being held in the jaws of the ordinary centering chuck, or by being thrust on the tapered plug arbor which supports such chuck in place thereof, it would only be necessary to provide the lathe with a stylus mounted on a diaphragm in order to make of it an operative phonograph containing all the essentials of a phonograph, both for recording and reproducing speech, although of course lacking in those structural details which characterize the perfected and highly specialized form of turning lathe which the modern phonograph constitutes. These remarks refer to the ordinary commercial phonograph used for making as well as reproducing sound records, and using wax-like records such as are contemplated by this Edison patent and are capable of being cut to form the record. Of course where the phonograph is used merely for reproducing sound, its cutting devices



may be omitted, but its construction and general operation are otherwise unchanged.

It thus appears that the phonogram blank of this Edison patent was to all intents and purposes the old phonogram blank of the Tainter patent; that it was practically identical in construction and absolutely identical in operation with the old blank, and that all Mr. Edison did to it was to avoid the necessity of its being carefully fitted to the cylinder or mandrel of the phonograph so as to be of the same exact diameter on its interior as such mandrel was on its exterior, by employing the ordinary expedient which was generally employed by mechanics in similar situations everywhere, of making the bore wedge shaped or tapering to fit a correspondingly tapered supporting mandrel, and that the adoption of this well-known expedient could call for any exercise of the inventive faculty is a proposition which needs only to be stated to reveal its absurdity. This being the case, it is unnecessary to consider the claims in detail, as a mere quotation of them will disclose that they do not even purport to contain anything further than the taper bore feature of a cylindric phonogram blank, which has been thus fully considered. The claims read:

"1. A phonogram-blank or phonogram having a bore tapered throughout its length, substantially as set forth.

"2. A phonogram-blank or phonogram having a cylindrical recording-surface and a tapering bore, substantially as set forth."

The third claim of the patent has not been declared on, but it may be remarked that it differs from the second claim only in specifying a recording surface of wax or wax-like material, which is not only specifically disclaimed by the specification as a novel feature of this pat-

*Deposition of Henry W. Carter.*

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ent, but has been shown to have been old in the Tainter patents. Nor is it necessary to discuss these claims with reference to defendants' construction, since as such claims are devoid of any features of patentable novelty, it is idle to consider the question of identity.

As additionally bearing on the question of novelty, however, attention might also be called to the fact that the second Tainter patent referred to, No. 375,579, filed July 7, 1887, and patented on December 27 of that year, showed a supporting mandrel or phonograph cylinder made tapering at one end for the purpose of frictionally engaging the blank in case the latter did not fit the mandrel with sufficient exactness. The specification states:

"The tablet holder (mandrel) increases at one end to a slightly larger diameter, as shown at 40, Figs. III and IV, so that the tablet 41, being pressed toward that end, will be held sufficiently tight to prevent slipping, even though the tablet fits quite loosely with respect to the main portion of the holder."

Omitting all other considerations, therefore, all that Edison claims to have done is to have extended the tapering of the mandrel throughout its length and made the phonogram blank of tapering bore to fit it. Undoubtedly the latter is the better construction, but it is equally undoubted that this step of making the fit between the mandrel and blank tapering throughout, followed naturally upon the making of a taper fit at one end only as one of the inevitable steps in the development of an art then in its infancy. As showing other examples of tapering fits between concentric rotating machinery parts, attention is also called to the patent to Birkmann, No. 309,288, of December 16, 1884, to Abbe, No. 277,097, of May 8, 1883, in which the hub A of the buffing wheel is tapered to fit frictionally upon the tapered mandrel or arbor



D of the polishing machine, to Locke, No. 170,178, of November 23, 1875, which shows a polishing arbor having a taper-bored sleeve D of sand paper adapted to fit removably over the projecting end of a plug arbor A, and to Phillips, No. 70,113, of October 22, 1867, which shows a taper-bored cylindric spool H fitting upon a taper spindle F to rotate therewith. Another familiar example of this construction is the bobbin-winding device of the old Wheeler & Wilson No. 8 sewing machine. This machine, as is well known, is a rotary shuttle machine having a cylindrical bobbin which is wound full of thread by being slipped endwise over a taper spindle mounted in proximity to the driving belt of the machine and provided with a little pulley wheel which may be made to engage such belt. The hole in the bobbin is concentric with its outer surface, and the bobbin is simply pushed over the taper mandrel until it binds frictionally thereon and is rotated as the spindle or mandrel is rotated. The hour hand of an ordinary clock is another familiar example of this taper fit between rotating parts, the sleeve which supports the hand being ordinarily bored out on a taper to fit over the rotating sleeve of the clock movement. In all of these cases the object of the construction is precisely the same as the object of the taper bore of the phonogram blank, to wit, to detachably connect the parts by a frictional engagement which will cause them to rotate concentrically and without any necessity of nice fitting. In all such cases concentric movement is desired and obtained, and in most cases it is as necessary, or more so, than in the case of the phonogram blank. In lathe chucks, for example, such as shown by Birkmann, or such as the taper-socketed centering chucks heretofore referred to, it is necessary that the chuck jaws or parts which support the work, or the tool, as the case may be, shall be abso-

*Deposition of Henry W. Carter.*

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lutely concentric under all ordinary circumstances with the mandrel or arbor which supports the chuck and with the spindle of the lathe upon which it is mounted. Indeed, it will be understood that the very name "centering chuck" means one in which the jaws are so geared or movably connected together that they always stand concentric to the axis of rotation of the chuck, which is equally and necessarily the axis of the taper bore and of the supporting mandrel which engages such bore.

Q. 6. Please state in the same way whether or not in your opinion "Complainant's Exhibit Defendants' Record" embodies the alleged invention described and illustrated in the Edison patent No. 382,462, of May 8, 1888?

A. We have already seen that prior to the date of this patent phonogram blanks were made with wax-like surfaces mounted on a backing of paper or the like. This paper backing, as shown in the prior Edison patent No. 382,418, just considered, and in the Tainter patents Nos. 341,288 and 375,579, was formed into a hollow cylinder, and its wax coating thus presented a cylindric recording surface to the action of the phonograph stylus. The patent now under consideration claims as its invention the omission of the supporting backing, or, in other words, the formation of the phonogram blank of that material alone, of which only its outer surface was previously formed. The three claims of the patent read:

"1. A phonogram-blank or phonogram constructed wholly of wax or wax-like materials and having the same coefficient of expansion throughout its mass, substantially as set forth.

"2. A phonogram-blank or phonogram constructed as a hollow cylinder wholly of wax or wax-like materials and having the same coefficient of expansion throughout its mass, substantially as set forth.



"3. A phonogram blank or phonogram constructed as a hollow cylinder, with a tapering bore wholly of wax or wax-like materials, and having the same coefficient of expansion throughout its mass, substantially as set forth."

The claims do not describe the character of the material called for, further than to state that it is "of wax or wax-like," and it will be noted that the specification itself throws no light on this question of material, except in the following recitation:

"I have found in practice that the most available surface for phonogram blanks and phonograms is one composed of wax, gum, or other plastic hydrocarbon."

For our understanding of the meaning of "wax or wax-like" in these claims we are therefore practically forced to resort to a consideration of the general understanding had of these terms at the date of the patent, and particularly of their acceptance at the time in this particular phonographic art. The Century Dictionary defines wax as follows:

"1. A thick, sticky substance secreted by bees and used to build their cells; the material of honey comb; bees-wax, in its natural state it is of a dull yellow color, and smells of honey. Its consistency varies with the temperature; it is ordinarily a pliable solid, readily melted. When purified and bleached it becomes translucent white, is less tenacious, without taste or smell, and of a specific gravity less than that of water. It softens at 80° F., becoming extremely plastic, and retaining any form in which it may be molded, like clay or putty, and melts at 158° F. In chemical composition, the wax consists of variable proportions of three substances, called myrocin, corelein, and cerotic acid. Wax is used for many purposes, both in its natural state and variously prepared. In pharmacy it enters into the composition of various plasters, ointments, and cerates as a vehicle

for the active ingredients, and to confer upon the preparation a desired consistency. It has varied uses in the plastic art, especially in the making of anatomical models, artificial flowers and fruit, casts and impressions of various kinds, etc.

"2. One of various substances and products resembling wax in appearance, consistency, plasticity, and the like, or used for like purposes (mentioning mineral wax or ozocerite, Brazil wax or Garnauba wax, Chinese wax, Japan wax, paraffin wax, etc.)"

The term "wax-like" does not appear in the dictionary, but the similar term "waxy" is described as:

"Resembling wax or putty in appearance, softness, plasticity, adhesiveness, or other properties; waxen; hence pliable; yielding; impressionable."

And I found by consulting half a dozen other dictionaries and technical works that substantially the above definitions of wax and wax-like or waxy are generally agreed upon and have been since a period long prior to the patent in suit.

Turning now to a consideration of these terms as employed in this particular art prior to the date of such patent we find this to be the situation: The phonograph as a machine for recording and reproducing speech was invented by Mr. Edison and first patented by him on February 19, 1878, No. 200,521, ten years prior to the date of the patent under consideration. In this original phonograph the record was indented on a cylinder wrapped with tin foil, or the like; and the machine, while successfully operative as a scientific curiosity, was commercially a failure, or at least did not come into any general use, except in a very limited way for exhibition purposes. Some eight years later, however, Messrs. Bell & Taintor proposed to substitute for the tin foil record of



the early Edison phonograph, in which the speech-recording groove was simply indented, a record made of wax or wax-like material, in which the speech-recording groove could be actually cut or engraved by the removal of the material of which the record was composed. In this patent, which I understand may be considered as the beginning of the phonographic art as a commercial possibility, they state:

"The invention consists, first, in the formation of the record or 'phonogram' as it has been called, by means of a cutting-style which is vibrated by the sound waves or sonorous vibrations to be recorded.

. . . . Heretofore the vibrating style has, as in Edison's well known phonograph, simply indented the recording material. . . . In this new or improved form of record not only may a larger number of words or sounds be recorded in a given surface than has been practicable with the indented record heretofore in use, but the recorded vibrations are also sharper and better defined. It is found that an indenting style smoothed over the crests of the larger elevations, and also rubs out some of the finer ones.

"The invention consists secondly in engraving or cutting the record in a waxy or amorphous and slightly cohesive substance. Preferably, a compound of bees-wax and paraffin (the latter in excess) is employed. This compound has no tendency to clog the style, but is readily moved thereby in chips or shavings. (p. 1). . . . The term "cutting" is herein employed to indicate an action in which the material is removed in chips, shavings, or other small pieces—as in engraving, turning and the like—and not simply displaced.

"The displacement of the material is not only a different operation from the cutting contemplated by this invention, but is not calculated to accomplish the objects for which cutting or engraving is employed." (P. 6, lines 70-80).

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And among the claims of this 1886 Bell & Tainter patent we find the following:

"9. The method of forming a sound or speech record, which consists in engraving or cutting the same in wax or a wax-like composition, substantially as described.

"10. The sound or speech record cut or engraved in wax or a wax-like composition, substantially as described.

"11. The recording tablet of a phonograph or sound record machine, having as the material for recording sounds or sonorous vibrations the composition of bees-wax and paraffin, substantially as described.

"12. A sound or speech record cut or engraved in a wax-like composition, such as the compound of bees-wax and paraffin, substantially as described."

This Bell & Tainter patent was followed by the two patents to Tainter alone, hereinbefore referred to as Nos. 341,288 of May 4, 1886, and 375,579 of December 27, 1887, both of which describe the same wax-like record in which the record line is cut or engraved, instead of merely indented, and in both of which this record or record tablet was made of cylindric form and in general appearance substantially like the modern cylindric record or phonogram blank. Moreover, in his patent No. 421,450 of February 18, 1890, but which was applied for on November 14, 1887, Tainter still further describes the necessary character of a record tablet or phonogram blank in order to successfully receive a cut as distinguished from an indented record, and in so doing gives a further clue to the meaning of "wax or wax-like," as those terms were used in this art at this time, which it will be noted was just prior to the Edison patent now under consideration. This description is as follows:

"This invention has reference to the preparation of



a recording surface or medium for graphophones or apparatus for recording and reproducing speech and other sounds wherein the sound record is cut or graven by a cutting-style in a surface, such as wax or waxy composition.

"There are certain properties or characteristics in the recording medium that are desirable or essential to the successful operation, and which are difficult, owing to their somewhat contradictory nature, to find combined in one substance. It is necessary that the substance be of the right degree of hardness and toughness without being brittle, and that it should not be susceptible to changes of temperature. Some waxes are too brittle, and instead of cutting smoothly and accurately under the cutting-style chip or break off, producing, of course, an inaccurate record. Even a slight degree of brittleness will unfit the substance for the use designed, and as a general rule those waxes that are sufficiently hard and fine in texture for the purpose have also the undesirable property of brittleness and lack toughness and coherence. Other waxes—such as bees-wax, for example—while cutting smoothly and evenly, are too susceptible to alterations of conditions under changes of temperature. Such waxes also become sticky, the shavings adhere to the record and other parts of the machine, and their use is attended with other inconveniences. Soft waxes, moreover, do not give in reproducing as loud or distinct articulation as harder waxes.

"Heretofore a composition of bees wax and paraffin has been used with good results, but it does not possess the essential characteristics in as high a degree as desirable.

"I have found after a long series of experiments that a certain natural or earth wax known as 'ozocerite' is eminently suitable for the purpose of forming graphophonic recording-surfaces, particularly when treated as hereinafter described. This wax is tough and smooth in texture. In recording it cuts out in a continuous shaving without breaking into short pieces or adhering to the tablet or other parts of the machine, and it cuts off close to the point of the cutting-style



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without chipping off below the same and therefore produces an accurate record."

At the time of and prior to this Edison patent, therefore, the properties or characteristics most desirable or essential in the recording medium or phonogram blank were recognized to be those by which such blank lent itself most readily to the operation of being smoothly cut or engraved by the cutting-style which produced the record groove, and as the substance which at that time seemed to most fully possess these essential properties or characteristics was wax, or a waxy compound, this designation was employed in the art to describe and define the desired record tablet or phonogram blank material. And this I understand to be what Mr. Edison meant in the patent under consideration, when he claimed his phonogram blank or phonogram "constructed wholly of wax or wax-like materials," *i. e.*, a material having those wax-like qualities which rendered it capable of being readily cut or engraved to form the record, as distinguished from being simply indented like the old tin foil record of his early phonograph. In this view the chemical composition of the substance is an immaterial matter, and obviously as no chemical re-action occurs in the use of the phonogram blank, this must necessarily be so, provided only the composition be such as to be stable and unchangeable under ordinary atmospheric and temperature conditions. Hence, I do not regard the description of the record material as a hydro-carbon (specification, line 11) as calling for that particular character of chemical composition necessarily, but assume that this term was used simply because wax, gum, and similar plastic material are ordinarily hydro-carbons. But I do regard the words of the claim "wax or wax-like" as necessarily and unavoidably demanding a material of



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such wax-like or waxy characteristics as will enable it to properly undergo the cutting operation by which the sound record is engraved upon the phonogram blank in the ordinary operation of the modern phonograph and in the ordinary method of producing phonograms for use in the modern phonogram. It appears that the use of material consisting principally of wax or of a combination of waxes, like the earlier Bell & Tainter and Edison record blanks has since given way entirely to the employment by complainants for ordinary phonographic purposes of a metallic soap or similar compound containing very little wax, but it will be noted that even as thus altered the essential characteristics of being capable of receiving the necessary cutting action has been steadfastly retained. And that this interpretation of the terms "wax or wax-like" as describing the necessary characteristic of the material of the record or phonogram blank of the claims under consideration is confirmed by Mr. Edison himself in his patent No. 393,967 of December 4, 1888, which was applied for and granted in the same year and within a very few months of this patent in suit. I quote from this later specification as follows:

"For the recording surface of my phonograph (*i. e.*, the phonogram blank), I employ a solid material such as a wax composition or a mixture of metallic soaps capable of being indented by the recording point. In recording sounds a groove is formed in the material by means of an indenting point connected with the diaphragm of the recorder, and this groove varies in depth accordingly as the indenting point is advanced or withdrawn by the vibrations of the diaphragm, thus causing the wave record from which the sounds are reproduced, as is well understood.

"Heretofore the recording point used has been constructed so that in forming the groove it removed

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the material by a scraping action, this was due to the fact that the advancing edge of the recording-style used was perpendicular, the result being a scraping rather than a true cutting of the material. The scraping action I find to be productive of false vibrations, which become a part of the record, and which are audible as scratching and other foreign noises when the sounds are reproduced. I have found that this difficulty is overcome by employing a recording point made as a true cutting tool with the cutting edge in advance of the stock of the tool. . . . The cutting of the record in the material of the recording-surface, instead of scraping it, makes a clean smooth record, free from imperfections, producing scratching or other foreign noises in the reproducing."

Adjourned till Saturday, March 8, at 10 o'clock  
A. M.

Chicago, March 8, 1902. Parties met pursuant to adjournment. Present as before.

It has already been pointed out also that these phonographic record cylinders were not only cut by the narrow-pointed tool which engraved the sound-recording spiral upon them, but by the broader smoothing tool used to pare off a record previously cut thereon so as to leave the surface free and smooth for a new record. In the words of Mr. Edison in his patent No. 406,571 of July 9, 1889, filed February 11, 1889:

"My improved phonograph, as is well known, is provided with a turning-off tool for turning off the surface of the phonogram-blank. This is mounted, preferably, to operate with the recorder, so that the old record will be turned off at the same time that a new record is made."

And again in Edison patent No. 393,463 of November



27, 1888, filed May 7, 1888, the day prior to the grant of the Edison patent under consideration:

"As has been made known by my prior applications for patents, the phonogram-blank which I prefer to employ is one made entirely of wax or a wax composition in the form of a cylinder having a cylindric outer surface and tapering bore. These blanks I first mould from the wax or wax composition; but owing to the excessive contraction of the wax in cooling, the blanks are somewhat distorted and do not have the accurate shape and size required. Hence it becomes necessary to mould the blanks slightly larger than the size of the finished size and then reduce them by cutting to the proper size and shape both externally and internally."

Clearly, therefore, the phonogram-blank or phonogram claimed in the Edison patent No. 382,462, now under consideration, was made of wax or wax-like material of such comparatively soft and easily cut nature as to be readily capable of being engraved by the cutting style or recorder, and of being readily pared off to bring it to proper shape and size originally and to efface previously impressed sound records and prepare its surface to be engraved anew in the recording of other sounds or speech. The record contemplated was made of wax-like material capable of being readily melted and poured into a mould, and they were and are still made in precisely this manner preparatory to being made use of by the cutting operation above referred to.

Turning now to defendants' record or phonogram-blank, I find that instead of being made wholly of wax or wax-like material, it is made wholly of celluloid, which is a material absolutely lacking in any wax-like characteristic whatsoever. Unlike wax, which is found in nature in many forms and the prototype of which group

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is the familiar bees-wax, celluloid is a purely artificial product composed principally of gun-cotton and camphor. The natural product which it most nearly resembles is ivory, and it possess so nearly the same characteristics of hardness, toughness and elasticity as ivory, that one of its principal uses is in the manufacture of artificial billiard balls, which, as is well known, are ordinarily and most desirably made of ivory. The Century Dictionary defines celluloid as:

"A substance made of gun-cotton, camphor, and some other ingredients, imitating ivory, or, when colored, tortoise-shell, coral, amber, malachite, etc."

It is also used for organ and piano keys, for combs, brush backs, mirror backs, and various other toilet articles, in place of ivory. It is used for the handles of cutlery, for card and cigar cases, match-boxes, napkin rings, optical goods, such as the frames of spectacles and eye-glasses. And in fact it is at the present day so commonly employed in all sorts of situations, and especially as a substitute for ivory, tortoise-shell, and similar expensive natural products, that its appearance and general characteristics may fairly be said to be at the present day a matter of common knowledge. But in no case, and under no circumstances of which I am aware or have been able to discover by a considerable investigation of the technical authorities on the subject, is it ever employed in place of or as a substitute for wax of any kind, or for the purposes to which wax or wax-like materials are devoted. Indeed, I think it may be said without fear of successful contradiction that aside from those interested in sustaining the contentions of complainants in this regard, it would be impossible to find in the entire country a single person who if asked to make a list of all wax and wax-like materials of which he had know-



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ledge would include celluloid among them. And the very evident reason for this is the fact above stated, and which cannot but be recognized as obvious to the most casual observer, that celluloid possesses not a single one of those characteristics which distinguish wax from other materials. Wax is comparatively soft and yielding and has but little elasticity. It melts at a low temperature, very much lower than the boiling point of water, and bees-wax, the prototype of the group, becomes so soft at a temperature less than blood-heat that it is plastic and readily moulded. Wax melts long before it burns, or at a much less degree of heat, and when melted may be readily poured into moulds, and at all ordinary temperatures it may be cut by even a very blunt edged instrument. And all this is not only true of wax in general and of the wax-like compositions in vogue at the date of these phonogram patents, but is true in great measure of the modern soap records made by complainant and which complainant's expert states are composed of only a slight proportion of wax. For I observe that these soap records have not only much the appearance and feel of wax, but that they soften and melt readily at about the temperature of boiling water, and when melted can be readily cast in moulds. It is, however, in regard to its cutting quality that the material of these soap phonogram-blanks in most noticeably wax-like. Complainant's expert describes this soap as very hard, but evidently it is only when compared with softer wax-like material or waxes that the word hard could be thus used. For these soap records of complainant's manufacture are actually so soft that they may be cut or gouged with the greatest readiness with the blunt point of a soft lead pencil, or with the thumb or finger nail, as the court can readily determine by trying it, and being thus soft, phono-

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gram blanks made of this material may of course be readily cut or engraved by the recording style of the phonograph to form the record thereon, and may as readily be pared off with the cutting knife of the phonograph to prepare the surface originally or anew to receive such engraved record.

Celluloid, on the other hand, is comparatively hard and unyielding, and is more nearly in this respect like ivory, bone, or hard rubber. It is very tough and elastic, and can only be cut with difficulty like these materials, or like ebony and other hard woods. These characteristics it retains at all ordinary temperatures, and I do not understand that it is capable of being melted at all, although at a high temperature of some fifty degrees or so above the boiling point of water it becomes plastic, and when heated beyond this point decomposes suddenly with reddish fumes. It takes fire readily and burns fiercely, much more so even than pine wood, but without any sign of softening or melting during the burning. And the difference between defendants' records and even the hard soap records of complainant in this respect will readily appear if a lighted match be applied to each. The celluloid record will flame up like a piece of dry paper and burn in much the same way, but the soap record will simply melt and liquefy at the point where the flame is applied.

Celluloid makes a stiff, strong and rigid record cylinder, which if distorted by pressure will resiliently resume its proper shape when released, even when made very thin, the thickness of the cylindric wall in practice being not much over one-thirty-second of an inch. Its tensile strength is very high and there is no danger of bursting even such thin cylinders in the act of forcing them upon the taper mandrel of the phonograph, and the general toughness of the records thus made is such that they may



be dropped on the floor and thrown about with comparative impunity. Wax or wax-like records on the other hand are so brittle and fragile that they must be made of several times the thickness of the celluloid record, and even then are liable to go to pieces if not handled with the greatest care, and this is true even of the hard soap records, which if dropped upon the floor are almost certain to fly to pieces. It has been pointed out that these soap records can be readily gouged with the thumb nail or with the blunt point of a soft lead pencil, but an attempt to mark or indent defendants' celluloid record in this manner will be found an abject failure. Indeed, it is only with the greatest difficulty that the celluloid record can be cut even with a sharp knife.

Now all this difference in the materials used in the records made by complainants and defendants, and which shows so conclusively the utter lack of any wax-like characteristics in the celluloid record, leads up to the significant fact that the reason for the omission of any wax-like characteristic in defendants' record is that the cutting process which demands such wax-like record characteristics in the phonogram blank of this Edison patent is not employed in and is utterly foreign to the manufacture and use of defendants' phonogram blank. This latter blank is not even formed by melting its material and pouring it into a mold. Instead, a celluloid tube of the desired diameter and thickness is cut to the proper length for the phonogram blank and its ends turned in by heat and pressure to form the end flanges which engage the mandrel or cylinder of the phonograph. The blank thus formed is then inserted in the metal die of slightly larger internal diameter than the external diameter of the celluloid tube. This die has formed on its interior a spiral rib so fine as to be almost invisible, but which in reality is the exact re-



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verse of the record groove which it is desired to provide on the celluloid phonogram. When placed in this die, the ends of the tube are closed and steam is admitted to its interior under a pressure corresponding with a temperature of between 250° and 300° Fahrenheit. This heat softens the celluloid sufficiently so that it expands under the steam pressure and is forced against the surrounding ribbed wall of the die until the outer surface of the blank receives the imprint of the rib and is made to perfectly conform thereto. The steam pressure is now released and the blank permitted to cool, during which process it shrinks sufficiently to enable it to be withdrawn endwise from the die, it remaining, however, permanently marked with the imprint which it received from the spiral rib on the surface of the die, and which imprint, as before stated, will be that of the record of sound vibrations which it is desired shall be reproduced when the phonogram is placed under the reproducing stylus of a phonograph. The phonogram is now complete and permanent. Being of tough, strong, elastic material, it will stand almost any abuse without breaking or permanent distortion. Being of a material impervious to temperature changes from the most severe cold to a degree of heat far above the boiling point of water, and being absolutely unaffected by moisture, it will remain unchanged in any climate or season. And being of a material which is hard as well as tough, and which it is difficult to cut or indent in the slightest, the delicate thread-like record on its surface will withstand any amount of ordinary handling and a large degree of positive abuse without having its perfect sound-producing qualities seriously impaired. Being of such strong, tough and resilient material also, it naturally and as a matter of course requires no supporting backing,



even though made so much thinner than complainant's wax-like record, and in fact almost as thin as the wax-like surface of the original Bell & Tainter and Edison records, which required and employed such supporting backing.

In all of these characteristics it differs from the record claimed in the Edison patent under consideration, and even from the complainant's modern soap record, the inclusion of which under the claims of this patent evidently must require such claims to be stretched to the utmost limit of liberal construction, so far do even these soap records depart from a truly wax or wax-like material. Complainant's records, whether of actual wax or of hard soap, are fragile, brittle and easily broken. They are weak and of low tensile strength and must be made of considerable thickness or they will be burst in placing them upon the phonograph cylinder or mandrel. They are soft and easily marred, so much so that their record surfaces cannot be handled even by bare hands without danger of obliterating the record. In the cold of ordinary winter weather they are exceedingly brittle and liable to fly to pieces, and the inadvertent placing of one upon a hot radiator will melt and destroy its record beyond hope of repair. (The placing of defendants' celluloid record upon a hot radiator for an indefinite period will not affect it in the slightest.) The wax-like softness of complainant's record or phonogram blank is a necessity of its process of manufacture, and is inevitably required by the cutting operation to which it is subjected, while the non wax-like hardness and toughness of defendants' phonogram is rendered possible by its utterly different process of manufacture and by the fact that it never requires to be cut or engraved. And, so far as the question of uniform expansion raised by the patent in controversy is concerned, defendants' phonogram blank

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can never under any circumstances have given rise to this question, since regardless of any disclosure contained in this Edison patent, the toughness, hardness and strength of the celluloid material employed by defendants rendered it inevitable that no backing of different material or degree of expansion should be required or employed. It cannot reasonably be believed that the inventor of this new process of forming phonogram records out of celluloid would have failed to have made them of a single uniform material, if this Edison patent had never been published or disclosed. Nor does it seem reasonable to me to hold that the inventor of this new process could have received any information or instruction whatever of value in this connection not already open to him in the prior Bell & Tainter and other patents heretofore referred to.

For these reasons, therefore, I am forced to the conclusion that defendants' celluloid record is not constructed either in whole or in part of wax or wax-like material, or of any equivalent of such material, and that consequently it does not answer to and is not covered by the claims of this Edison patent No. 382,462, of May 8, 1888.

Adjourned till Monday, March 10, at 10 o'clock  
A. M.

March 10, 1902. Parties met pursuant to adjournment. Present as before.

In reaching this conclusion I have not overlooked the attempt of complainant's expert to define wax or wax-like in such a way as to distinguish the alleged invention and yet include celluloid within the definition. I quote from his cross-examination as follows:

"22 X-Q. What is the usual construction properly placed upon the word 'wax' or 'wax-like' by the English language?



"A. So far as physical properties are concerned, a wax is an amorphous material, solid at ordinary temperatures, varying in hardness according to different varieties, of many shades of color, more or less brittle when subjected to considerable cold, and more or less plastic when subjected to heat. A wax-like material, to my mind, might be a material having any of these characteristics, since that expression is broad; but for the purposes of this case, I consider a wax-like material to be any amorphous and sufficiently hard substance suitable for use as a phonographic record. It does not seem to me that we are dealing so much with material in the consideration of these patents as we are with mechanical constructions."

A more pertinent example of a definition which does not define could hardly be found, and its absurdity as forming the basis of any conclusion in this case will appear when it is considered that this definition will cover the widest range of substances, from butter and cheese on the one hand to glass on the other. Indeed, glass is a most perfect example of an amorphous material corresponding to this definition. Glass is solid at ordinary temperatures. Glass is of varying hardness, according to different varieties. Glass is of many shades and colors. Glass is more or less brittle when subjected to considerable cold, and more or less plastic when subjected to heat. It is, in fact, perfectly plastic when heated and may be moulded, bent, twisted, rolled or drawn out, in any way or into any shape, or after any form desired. And there appears to be no reason why, if handled according to defendants' process of manufacture, glass is not "an amorphous and sufficiently hard substance suitable for use as a phonographic record." But the absurdity of calling glass "wax-like" in any sense whatever is too apparent for words.

Hard rubber is another substance which equally well fulfills the definition. It also is an amorphous material, solid at ordinary temperatures, varying in hardness according to different varieties, of many shades of color, more or less brittle when subjected to considerable cold and more or less plastic when subjected to heat. Hard rubber is an "amorphous and sufficiently hard substance suitable for use as a phonographic record," and I am informed that satisfactory phonographic records have actually been made out of hard rubber by defendants' process. But, equally with glass, hard rubber is lacking in any wax-like quality whatever, and like celluloid hard rubber is lacking particularly in that wax-like characteristic which would enable it to be readily cut or engraved to form a sound record according to the ordinary cutting process, which it has been shown must have been contemplated by this Edison patent. And many metals, such as lead, are amorphous materials, solid at ordinary temperatures, varying in hardness according to the different varieties, of many shades of color, and more or less brittle and more or less plastic under varying conditions of temperature. And, undoubtedly, many metals of this character are capable of use as phonographic records, but it would certainly be an unheard of use of language to designate any record so made as of "wax or wax-like" material.

Moreover, with regard to the word "amorphous," on which such stress seems to be laid by complainant's expert throughout his deposition in defining wax or wax-like, attention is called to the fact that this is not so much a characteristic of particular materials as a state which the same material may or may not be in, according to the treatment which it has undergone. The word is defined in Webster as:

"A state of being without crystallization even in



the minutest particles, as in glass, opal, etc. There are stony substances which, when fused, may cool as glass or as stone; the glass-state is sometimes spoken of as a state of amorphism."

But while ice, for example, in its ordinary condition is of the highest type of crystalline material, it may be changed to an amorphous state by pressure, and just so metals are commonly changed from a crystalline to an amorphous state by squeezing or hammering, so that it is useless to attempt by this word to distinguish the materials themselves. I would call attention also to the fact that the word "amorphous" does not appear in the patent, and that it is not necessarily characteristic of wax, although generally so, and that there appears to be no good reason for placing particular stress on this characteristic of ordinary wax, any more than on other ordinary wax-like characteristics, such as its chemical composition, which it is admitted are immaterial to this discussion. In fact, since it appears that glass, which is absolutely unwax-like in every essential, is the highest example and type of amorphous materials, there seems to be every reason for omitting this attribute in a distinguishing definition of the wax or wax-like material herein contemplated. All of which goes to further emphasize the correctness of the conclusion above reached, that the wax or wax-like characteristic contemplated by this Edison patent is that by which the material readily lends itself to the cutting process by which phonographic sound records were at that time, and still are, ordinarily produced, and the correctness of the further conclusion that celluloid, in the absence of this characteristic, is not a wax or wax-like material within the meaning of the patent, any more than glass or hard rubber, both of which, equally with celluloid, fulfill the conditions of complainant's expert's definition of such material.

*Deposition of Henry W. Carter.*

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Nor have I in reaching this conclusion ignored the possibility which, for aught I know, may exist, that celluloid, hard rubber or even glass records may be produced by a cutting process, instead of by defendants' method, or that complainant's wax or soap record may be made perhaps by defendants' method, instead of by cutting. As to whether or not these possibilities are actualities, I am not informed, but whether they are or not is equally immaterial. The point of the conclusion reached is not that celluloid, hard rubber or glass cannot possibly be cut or engraved, for it is well known that under certain conditions they can be, and if at all, then possibly to form sound records or phonograms. But the point is that these materials, including celluloid, do not possess any wax-like characteristic which readily lends itself to such cutting operation, but, on the contrary, are distinctly unwax-like in being of a refractory and difficult to cut nature, and that being without such characteristic these materials, and particularly celluloid, are not covered by the claims of this Edison patent, in which such wax-like characteristic is made an essential.

In this view, also, it is unnecessary to consider whether or not this Edison patent contains any disclosure of patentable novelty, although the fact that it does not is, in my opinion, equally as clear as the fact that celluloid is not a wax or wax-like material. Cylindric phonogram blanks or phonograms having a thin surface of wax or wax-like material to receive the sound record have been shown to have been, and admittedly were, old at the date of this alleged invention, and to simply thicken this surface until it becomes a body or layer sufficient of its own strength and without a special strengthening backing to stand alone and resist the known strains incident to its use, seems to me to be the most obvious of expedients



and a most inevitable development of the art. And in this connection it will be noted that there can be no contention made here of a long-felt want which others recognized, but were unable to fill, the fact being that this patent was brought out at the very infancy of the art and is in itself proof that the want was immediately felt and as immediately and naturally supplied. How, indeed, could it have been otherwise? One of the obvious requirements of a phonogram blank for ordinary commercial use is that it shall be capable of being used over again after its first record has ceased to be of value or interest. And the most obvious way to prepare its cylindric surface for a new record was to pare or shave off enough of the easily cut wax or wax-like material to leave a fresh cylindric surface ready for a subsequent cutting operation. But in order to be capable of being repeatedly pared or shaved off, the wax surface must necessarily be of some considerable thickness, and when made thick enough it required no backing. The progress in the development of the art from a wax-surfaced cylinder merely, to one constructed wholly of wax, because made so thick as to require no strengthening backing, was thus but a natural mechanical sequence which must inevitably have occurred, regardless of any particular workers along this line.

There is more or less said in the patent, and considerable in the deposition of complainant's expert, about the different coefficients of expansion between the wax surface and its backing and the difficulties which resulted therefrom, but all this, while true, sounds to me simply like a labored attempt to inject into a very simple and natural mechanical development some quality of invention, by dilating upon the interesting but obvious scientific phenomena which attended it. The different action, in respect to expansion and contraction, of different ma-



materials under varying conditions of heat, or cold, or moisture, or dryness is a matter of common knowledge and must be taken into account in almost every art and in almost every kind of mechanical structure. And the difficulty of intimately uniting separate layers of different materials without incurring the liability of cracking one or the other layer by reason of the unequal expansion or contraction of the two materials, is equally well recognized and has been for generations, as is also the fact that the difficulty can be avoided by the use of only one material instead of different materials. In the enameling of cooking utensils, for example, the problem has always been to get a sufficiently refractory enamel which would not crack and chip off as the metal body of the utensil expanded when heated and contracted again when permitted to cool, and this is exactly the difficulty which this Edison patent points out was met with in the old paper-backed wax record cylinder. But Edison did not solve any problem or provide any new way of overcoming the difficulty in proposing his solid wax record. He simply avoided the difficulty by making the wax record entirely of the one material, just as the difficulty of making a glazed iron pot may be avoided by making the pot entirely of iron. The subject-matter which the patentee was working with related, it is true, to a new art, there was nothing peculiar to this new art in the difficulty which the patent sets forth, and no originality in the proposed manner of avoiding the difficulty, and such patent is, in my judgment, entirely lacking in patentable novelty.

Q. 7. Please state in the same way whether or not, in your opinion, "Complainant's Exhibit Defendants' Record" embodies the alleged invention described and illustrated in Edison patent No. 414,761, of November 12, 1889?



66      *Deposition of Henry W. Carter.*

A. The fact has been referred to that complainant's phonogram blanks or record cylinders are made by melting the wax or wax-like material and casting it in a mold. This patent particularly describes the process and illustrates the mold used, and also particularly sets forth the advantages which arise from providing the interior of the cylindrical phonogram blank with ribs, flanges or projections to engage the mandrel or cylinder of the phonograph at intervals, instead of opposing a continuous contacting surface thereto. The particular form of record shown in the patent is a spiral one, and it is pointed out that this spiral rib is advantageous over other forms, in that "it is easier to remove such a blank from the core than one having a smooth inner surface, since by slightly turning or screwing the same, it can readily be withdrawn." The second claim of the patent particularly specifies this spiral form of rib, but claims 1 and 3 of the patent are not so limited, in terms, and I understand that these alone are declared on herein. These claims read:

"1. A tubular phonogram-blank provided with internal ribs or projections, substantially as set forth.

"3. A tubular phonogram-blank made of moulded material and moulded with ribs or projections on its inner surface, substantially as set forth."

It will be noted that the latter of these two claims particularly specifies a phonogram blank made of *moulded* material, and having its internal ribs or projections *moulded* on its inner surface. The first claim is not in terms thus limited to a phonogram blank cast in a mould, but it appears from the specification that this sort of blank is the one which the patent particularly contemplates. Thus, in lines 59 *et seq*, which have been quoted by complainant's expert and need not be here repeated, it

is pointed out that in the process of casting the record cylinder it is liable to contraction and warping, and may require to be cut or reamed out to fit the mandrel of the phonograph, and that for this reason the casting of ribs on its inner surface is desirable as rendering the cutting or reaming process less difficult.

Now, if understood as so limited to a wax or wax-like record cylinder cast in a mould and with a series of ribs or spiral projecting turns provided at intervals along the interior bore or surface of the cylinder, it may possibly be that there is some basis for holding these claims to disclose an inventive act or possess patentable novelty, although even this is doubtful, but under any more liberal construction, the lack of patentable novelty in these claims is most apparent. What they then purport to cover is nothing more than the ordinary and universal practice, common for generations, if not for centuries, of cutting or boring out the interiors of cylinders, drums and hubs generally, for the purpose of reducing the machine work necessary to ream or cut them out to fit the mandrel or shaft upon which they are designed to be placed, and for the purpose of saving weight and material. This practice is illustrated, for example, in the tracing which I have had made of Fig. 430, page 607, of Dr. Erasmus Kittler's "Handbuch der Elektrotechnik," published at Stuttgart in 1886. The figure represents a sectional view of an electric dynamo invented by this same patentee, Thomas A. Edison, and manufactured by the German company formed to exploit his inventions in this line of electricity, the "Deutsche Edison Gesellschaft." It will be noted that the drum or hub A of the commutator in this figure is cut or cored out between its ends, at *a*, so that only the extremities *b* of the bore fit the shaft S upon which the commutator is mounted. Just so the hub or drum C of



the armature is cut away between its ends at *c*, so that only the extremities *b* of its bore fit the shaft *S*. And the object of this cutting away of the interior of the bore and its results are precisely the same which it is now claimed were original with Edison in this phonograph record patent, to wit, to reduce the length of bearing surface which must be cut or reamed out to make the parts fit upon the mandrel or shaft and to save weight and material (the latter object is not mentioned in the patent, but is set forth in the deposition of complainant's expert as one of the advantages of the alleged invention). And I can testify of my own knowledge and experience that this expedient was generally employed and adopted by mechanics and machinists prior to the year 1887, and in fact at the time of my early shop experience in 1883. The practice is and was so common, indeed, that it cannot fairly be called anything else than a mere shop expedient, and although it is an important expedient in many cases, as complainant's expert calls it, it certainly was not at the date of this Edison patent an ingenious expedient, nor did it call for any exercise of the inventive faculty, or for anything more than the most obvious mechanical skill and understanding.

Now, it has already been pointed out that defendants' celluloid records are not molded, but are simply cut to the desired length from previously formed celluloid tubes, and that their end flanges which project inwardly to engage the mandrel or phonograph cylinder are formed by turning in the end edges by the simultaneous application of heat and pressure. Defendants' phonogram blank is thus not made of molded material and is not molded with ribs or projections on its inner surface, as specified by claim 3, and the only sense in which it has any ribs or projections at all is the same sense in which the commuta-



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tor hub A or the armature drum C has at its end portions *b*, in Fig. 430 of Kittler's book above referred to. And as previously pointed out, these end ribs or engaging surfaces *b* of this Edison dynamo are just what is present in every drum, pulley or cylinder which is cored out centrally according to the common practice in order to save material and decrease the surface which it is necessary to cut away in order to bring the bore to the desired size. Defendants' construction in this respect, therefore, borrows nothing from this Edison patent, but resembles the device of that patent, in so far as it resembles it at all, only in and to the extent that both devices adopt and make use of the same obvious and well-known expedient generally adopted under similar circumstances and in similar situations throughout the entire realm of mechanic arts. This Edison patent, if valid at all, must be understood as meaning the precise form of molded or cast record which the patent describes and illustrates, and when so understood its claims do not read upon or cover defendants' construction.

Q. 8. Please examine the defendants' record before you, and particularly the little fillets intermediate the straight flange and the inner surface of the cylinder, and state what the function of such piece is and how they are put in place?

A. The little fillets you refer to are three in number and are placed equidistant about the inner surface of the record at that end thereof which last passes over the mandrel. They are inclined or bevelled on their inner faces, and their function is to act as a guide to direct the end of the mandrel through the bore of the end flange and prevent it from striking against the latter. They are simply a convenience in placing the record upon the mandrel or cylinder of the phonograph, and I understand that they



are cemented in place after the blank is otherwise completed.

Q. 9. I notice that in one of your answers you state that for all you know it might be possible to cut or engrave a sound record in a celluloid phonogram blank like "Complainant's Exhibit Defendants' Record." Have you ever known of this being done?

A. I have not, and my statement referred to was not intended to convey that impression, but was made merely in connection with the consideration of the bare possibility. On the contrary, it is my understanding and opinion that the material of defendants' record is so hard that it is utterly impracticable to cut or engrave a sound record thereon with any ordinary phonographic machine under any ordinary working conditions.

Complainant's counsel admits for the purposes of this case that the several books and periodicals referred to by the witness were published during the years of their respective dates, to wit: "Rose's Modern Machine Shop Practice," in 1887, "Appleton's Cyclopedia of Mechanics," in 1884, Vol. 35 of the Scientific American in 1876, Vol. 36 of the same in 1877 and "Kittler's Handbuch der Elektrotechnik" in 1886; and it is agreed that tracings or other reproductions of the figures referred to in these works (subject to correction if necessary) may be made a part of this record and used at the hearing with the same force and effect as though the works themselves had been introduced. It is also agreed that ordinary Patent Office copies of patents may be introduced with the same force and effect as though certified, such copies being subject to correction if necessary.

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Counsel for defendants here offers in evidence copies of U. S. letters patent as follows:

Patent to Tainter, No. 341,288, of May 4, 1886, and the same is marked "Defendants' Exhibit Tainter Patent No. 341,288."

Patent to Tainter, No. 375,579, of December 27, 1887, and the same is marked "Defendants' Exhibit Tainter Patent No. 375,579."

Patent to Birkman, No. 309,288, of December 16, 1884, and the same is marked "Defendants' Exhibit Birkman Patent."

Patent to Abbe, No. 277,097, of May 8, 1883, and the same is marked "Defendants' Exhibit Abbe Patent."

Patent to Locke, No. 170,178, of November 23, 1875, and the same is marked "Defendants' Exhibit Locke Patent."

Patent to Phillips, No. 70,113, of October 22, 1867, and the same is marked "Defendants' Exhibit Phillips Patent."

Patent to Edison, No. 200,521, of February 19, 1878, and the same is marked "Defendants' Exhibit Edison Patent No. 200,521."

Patent to Bell & Tainter, No. 341,214, of May 4, 1886, and the same is marked "Defendants' Exhibit Bell & Tainter Patent."

Patent to Tainter, No. 421,450, of February 18, 1890, and the same is marked "Defendants' Exhibit Tainter Patent No. 421,450."

Patent to Edison, No. 393,967, of December 4, 1888, and the same is marked "Defendants' Exhibit Edison Patent No. 393,967."

Patent to Edison No. 406,571 of July 9, 1889,



and the same is marked "Defendants' Exhibit Edison Patent No. 406,571."

Patent to Edison No. 393,463 of November 27, 1888, and the same is marked "Defendants' Exhibit Edison Patent No. 393,463."

Counsel for defendants also offers in evidence the following reproductions of the figures of the several publications referred to by the witness, to wit:

Of Figs. 480, 494, 497, 777, 795, 819 and 820 of Rose's Modern Machine Shop Practice, and the same are marked respectively "Defendants' Exhibits A, B, C, D, E, F and G."

Of Figs. 2624, 2625 of Appleton's Cyclopedia of Mechanics, and the same is marked "Defendants' Exhibits H."

Of the figure on page 210 of Vol. 35 of the Scientific American, and of the figure on page 118 of Vol. 36 of the Scientific American, and the same are marked respectively "Defendants' Exhibits J and K."

Of Fig. 430 of Kittler's Handbuch der Elektrotechnik, and the same is marked "Defendants' Exhibit L."

Adjourned subject to agreement of counsel.

Chicago, April 8, 1902. Parties met pursuant to agreement. Present as before.

*Cross-Examination by Mr. Dyer.*

X-Q. 1. Are you familiar with the development of the modern phonograph between the years 1886 and 1889?

A. Only as I have studied the patents relating to the art which were issued or applied for during those years.

X-Q. 2. As I understand your deposition, "Defendants' Exhibits A, B, C and E" respectively, which are taken from the book on Modern Machine Shop Practice, show examples in lathe construction and operation where tapered live centers have been held frictionally in the tapered bores of live spindles. Is this correct?

A. That is correct, with the understanding that the left-hand end of the plug arbor shown by Exhibit E should be understood to be tapered to fit the tapered socket in the live spindle of the lathe. I merely used this illustration because the nearest to the construction I had in mind which was ready at hand.

X-Q. 3. So far as this class of devices is concerned, am I to understand that Exhibit E adds anything to the other exhibits in the class?

A. Yes, it shows the projecting tapered end on which the tapered socketed chuck which I refer to is in practice mounted. In other words, the live centers of Exhibits A and B are ordinary lathe centers which terminate at their outer end in a conical point by which the piece to be turned is centrally supported with relation to the spindle, whereas the plug arbor which supports the taper socketed chuck has its outer end tapered to correspond with the socket in the chuck after the manner shown at the right-hand end of Exhibit E. The nut on this exhibit is placed there for the purpose of enabling the chuck to be forced off the arbor when it is desired to remove it. By turning the nut a gradual pressure can obviously be brought to bear against the end of the chuck until the latter is loosened or unseated. Without such nut it would require to be hammered off, and thus might be damaged in the operation. Of course it will be understood also that a plug arbor made exactly as shown in this Exhibit E, or with its left-hand end parallel and cylindric, might



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also be used to support a taper socketed chuck in the manner described if the cylindric end of the arbor was itself supported in a centering chuck by which it would be held concentric with the spindle, just as though made tapering and inserted in the taper socket of the spindle.

In this connection I notice my answer to your X-Q. 2 was inaccurate as regards Exhibit C in the respect that this exhibit shows a tail spindle and dead center instead of a live spindle and live center. The construction is the same, however, with the sole exception that the parts are not made to revolve, but are made to move longitudinally.

X-Q. 4. And, as I understand you, instances in the same art where taper socketed chucks are sustained on plug arbors are shown in Defendants' Exhibits F, G, H, J and K respectively. Is this correct?

A. That is correct, the ends of the plug arbors being actually shown in Exhibits H and K only.

X-Q. 5. And, as I understand you, an instance in this art where a cylindrically-bored washer is supported upon and driven frictionally by a mandrel having a taper of one one-thousandth of an inch is shown by Defendants' Exhibit D. Is this correct?

A. I introduced this exhibit for the purpose of showing the ordinary method of mounting work to be turned between the centers of a lathe in cases where the work has a central aperture or bore through which a mandrel can be forced. In this figure the part W, which you refer to as a washer, is simply a conventional representation of any piece to be turned, and might be a pulley or anything else, so far as this illustration goes. The mandrel M used in such cases is almost invariably a taper mandrel, and the amount which it is tapered depends entirely upon the circumstances under which the work is accomplished and the shop in which it is done. In my experi-

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ence a taper of so little as one one-thousandth of an inch is very unusual, and, on the other hand, a taper of many times that amount in a length of six or eight inches is very much more common. The principle, however, is the same in any case, *i. e.*, the supporting of the work concentrically of the lathe spindles by driving it upon a taper mandrel until it is tightly held thereon by friction, and I have myself practiced this method of supporting pieces which I was turning in thousands of instances, and at a date prior to the patents in suit.

X-Q. 6. But so far as this exhibit is concerned, and viewing it as it is described in the book in question, is not my characterization of the exhibit entirely correct?

A. The exhibit shows a tapered mandrel supporting a piece of work to be turned. It does not show, and was not intended to show, or introduced for the purpose of showing, any particular amount of taper or any particular dimension of mandrel or of work. If you mean to ask whether or not the text accompanying the Figure 777 of "Modern Machine Shop Practice," from which this exhibit is copied, describes the amount of the taper of the mandrel, my answer is that I do not know. If you wish I will examine the text and see what it says with regard to it.

X-Q. 7. Kindly examine the text and state whether or not my characterization of the exhibit is correct, and if not, please point out in what respect I am in error.

A. I have already pointed out that your characterization of the exhibit, as an exhibit in this case, is incorrect in assuming that it shows or is intended to show any particular dimensions or amount of taper, the illustration having been used merely as an illustration of what was familiar practice with mechanics prior to the date of the patents in suit, *i. e.*, the supporting of work to be turned



upon a tapered mandrel. Since, however, you wish the text of "Modern Machine Shop Practice" which appears in connection with the figure from which this exhibit is copied, I quote as follows:

"The mandrel diameter is made slightly larger at D than at C so as to accommodate any slight variation in the diameter of holes bored by standard reamers, which gradually reduce in diameter by wear; thus if a reamer be made 1.001 inch diameter, with a limit of wear of .001 inch, then the mandrel may be made 1 inch at C and 1.001 inch at D."

X-Q. 8. Does it not appear from this description which you quote that the purpose of making the mandrel very slightly tapered is to enable it to receive the bores of washers and other work, the diameter of which bores may vary within very narrow limits owing to the wear on the reamers by which they are formed?

A. That is evidently true of this description, but it should be understood that such was not the purpose of tapering the mandrels for the ordinary lathe work which I have described and in connection with which I cited this figure as the most familiar illustration. On the contrary, the object of tapering the mandrel was to make it fit the work tightly by wedging into the bore thereof. Of course, however, it necessarily follows that any tapered construction will accommodate bores varying somewhat in diameter, since if the diameter of the bore is larger it is only necessary to force it further up on the paper. Indeed, the pointing out by the Edison patent on the taper-bored phonogram blank that blanks of different lengths can thereby be accommodated on the same supporting mandrel is nothing more than a recognition of this obvious fact.

So much of the answer as follows the word "de-

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scription" in the first line is objected to as not responsive.

X-Q. 9. And is it also not a fact that so far as this exhibit D is concerned and so far as concerns the description thereof in the work in question, the provision of this slight taper of the mandrel would not be necessary if reamers of uniform diameter were used to bore the work?

A. So far as this exhibit D is concerned, and so far as the purposes for which it was introduced are concerned, the provision of the taper on the mandrel is a necessary incident of its construction, and is necessary to its operation as it was intended to operate, and as I have described it as operating. So far as the text of the description of Figure 777 in "Modern Machine Shop Practice" is concerned, it may be true that such text contemplated a merely cylindrical mandrel in which the taper was only provided to accommodate differences in the bore of the work caused by the use of reamers of different diameters, and in such case it is true as you state that "the provision of this slight taper of the mandrel would not be necessary if reamers of uniform diameter were used to bore the work." I am familiar with the use of cylindrical mandrels in this way, and the text is perfectly correct in describing such mandrels and in describing the slight taper provided to off-set the wear of the reamers, but it is not of this class of mandrels of which I am speaking, and for the purpose of illustrating the general form and manner of using which I referred to this Figure 777 as the nearest illustration close at hand. It will, however, be understood that the illustration would appear substantially unchanged, even if specially made to illustrate the taper mandrel construction which I have in mind, since the difference is only in the degree of the taper, and



would in any case be hardly visible to the eye in the length of mandrel shown.

X-Q. 10. What I am trying to do, if possible, is to arrange the several exhibits which have been taken from his book on "Modern Machine Shop Practice" in such a classification as to enable me to get your views of each class. With this explanation, is it not a fact that so far as Defendants' Exhibit D is concerned, and so far as that exhibit may be explained by anything in the text, it shows an instance in lathe operation where cylindrically bored work is frictionally rotated by a mandrel, the taper of which is slight and intended to compensate for wear in the reamers, by which the work is bored?

A. That is not quite correct, so far as this exhibit illustrates what I have testified was a common practice in the art with respect to this method of supporting work to be turned, and it was as such illustration that I introduced it. So far as the figure from which the illustration is taken is explained by the text of the work in question, you are correct, but as to my own explanation of the common practice which this exhibit illustrates, you are incorrect as to the last part of your assumption, *i. e.*, that the taper was provided for the purpose of merely compensating for reamer wear. This purpose was merely incidental. The main purpose was to secure a wedging action between the work and the taper mandrel which would make a sufficiently tight or frictional engagement between them to cause the work to revolve against the resistance of the cutting tool when the mandrel was rotated.

X-Q. 11. Would eight inches be an average length for one of these mandrels?

A. I think they would average a little longer than that, although of course that is a matter which depends entirely on the character of the work and the situation in which

the mandrel was employed. My most vivid recollection of the use of these mandrels is connected with the shops of the Edward P. Allis Company, at Milwaukee, in which I was employed during the year 1886. At one place in the shop, or room in which I was working, there was a pile of I should think twenty or thirty such mandrels, of varying dimensions, and my impression is that the average total length was about one foot, including a portion at each end which was reduced diameter and flattened off to receive the lathe dog by which the mandrel was driven, this reduced portion being similar to that marked A at the left hand end of Exhibit D. The length of each of these reduced portions was usually between one and two inches, which would leave the length of the intermediate or tapered body of the mandrel from eight to ten inches long.

X-Q. 12. Assuming the mandrel shown in Exhibit E to be of average length of, say, eight inches, then the taper referred to in the text describing this figure would be equivalent to a taper of one inch in eight thousand inches. Is this correct?

A. That is correct.

X-Q. 13. Of the three classes of exhibits found by you in the book on Machine Shop Practice, which class do you regard as most analogous to the construction disclosed in Edison patent No. 382,418 in suit? In the first class I include Defendants' Exhibits A, B, C and E; in the second class I include Defendants' Exhibits F, G, H, J and K; and in the third class I include Exhibit D.

A. There is very little difference between them in this respect, and especially between Exhibits A, B, C and E and Exhibits F, G, H, J and K. Exhibit D is perhaps not quite so much in point, for the reason that the essence of the claim of patent 382,418 relates to the tapered bore,



and not to a tapered mandrel (although of course a taper mandrel is necessarily implied as a means of using the taper bored blank), whereas Exhibit D, while it shows a tapered mandrel, does not show a tapered bore in the work placed upon the mandrel, except as the bore of the work is forced into a tapered shape by the compression of the material surrounding it when wedged upon the mandrel. In this connection also I would call attention to the fact that the first and second classes of exhibits, as you have divided them, overlap, in that the plug arbor of Exhibit E of the first class is the same plug arbor shown in Exhibits H and K of the second class, thus rendering it still more difficult to distinguish between the classes. Including the plug arbor with the second instead of the first class of exhibits, it may perhaps be said that the second class, in outward form, most obviously discloses the essential feature of alleged novelty in the patent referred to, since the tapered bore chuck is the outer or driven part of the exhibit, just as the tapered bore phonogram blank of the patent is the outer or driven part when mounted upon the mandrel of the phonograph. In the first class of exhibits the driving part, *i. e.*, the live spindle, is the part which is provided with the tapered bore, whereas the externally tapered part, which corresponds with the mandrel of the phonograph in this respect, is the part which is driven. Of course, mechanically this is a mere difference of outward form and is quite immaterial, or is what is commonly termed a mere reversal, it being obviously true that the essential result of supporting the one part concentrically and friction tight with relation to the other, so that they will rotate together about a common axis, is equally achieved in either case.

X-Q. 14. So far as these exhibits which we have considered are concerned, I understand that you regard the



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exhibits of the second class (Exhibits F, G, H, J and K) to be most nearly analogous to the device of the Edison patent in question, if we add to that class Exhibit E from the first class and assume that the plug arbor of this latter exhibit is tapered on its left-hand end to take into a tapered live spindle. Is this correct?

A. As I stated in my last answer, there is very little difference between the exhibits, in the respect mentioned, but to whatever extent a choice may be made, it may perhaps lie about as you have stated it.

X-Q. 15. Taking the exhibits of the second class, do Exhibits F, G, H and J add anything to Exhibit K?

A. Merely in showing different forms of chuck jaws. In so far as the taper socket feature is concerned, they are all alike. Indeed, the chuck shown in Exhibit H appears to be the identical chuck shown in Exhibit K.

X-Q. 16. Is it not possible, then, by a process of exclusion to limit the exhibits which we have so far considered to Exhibit E (Fig. 795 of Modern Machine Shop Practice) and Exhibit K (Vol. 36, page 118, Scientific American) and assume that the arbor of the latter exhibit is the plug arbor of Exhibit E, which latter arbor is tapered at its left hand end and supported within the tapered live spindle of the lathe? Do not these two exhibits thus considered collectively represent your view of the closest approach to the suggestion of the Edison patent in question?

A. I have already stated to what extent the several exhibits referred to may be distinguished in my view, according to your classification, and I see no reason for undertaking any process of exclusion by which attention would be confined to any one or more of them, except possibly as to Exhibits H and K, which, as I have before stated, appear to illustrate the same identical chuck con-



struction. The exhibits are neither so numerous nor so complicated that it is difficult to bear them in mind, and while in the main the Exhibits E and K which you have segregated out may be considered typical of the prior art in the respects under consideration, I am not prepared to say that in any further discussion it may not seem to me proper and desirable to refer to some of the other exhibits, and I see no reason why in such case I should not do so.

Adjourned till Wednesday, April 9, 1902, at 10 o'clock A. M.

April 9, 1902. Parties met pursuant to agreement. Present as before.

X-Q. 17. Assuming the plug arbor of Exhibit E to be carried in a tapered live spindle, do Exhibits A, B and C add anything to Exhibit E, so far as disclosing the feature of lathe practice which you consider analogous to Edison's suggestion?

A. If you are assuming a live spindle such as that shown at S in Exhibit B, they do not. In other words, the construction resulting from your assumption would simply be that of Exhibit B with the plug arbor fitting into the tapered socket of the spindle, in place of the live center T.

X-Q. 18. Assuming the socket chuck of Exhibit K to be carried on the plug arbor of Exhibit E, do Exhibits F, G, H and J add anything to Exhibit K, so far as disclosing the feature of lathe practice which you consider analogous to Edison's suggestion?

A. I have already pointed out that Exhibits H and K show the same identical construction. Exhibit F shows more clearly than Exhibit K a form of jaw adapted to seize work on its outer cylindrically turned surface, as well

as at its center. Exhibits G and J appear to be substantially like Exhibits H and K under the conditions in question.

X-Q. 19. I recognize of course that the exhibits in question differ in specific detail. What I want to know is, whether as disclosing a practice or custom which you regard as analogous to Edison's suggestion, Exhibits F, G, H and J add to or supplement Exhibit K?

A. Exhibit H adds to or supplements Exhibit K only in showing a face view as well as a sectional view of the same chuck. Exhibit F supplements Exhibit K in better showing a construction in which the cylindric conformation of the outer surfaces as well as the inner surfaces of the jaws is made use of, or may be made use of to support work concentrically of the tapered socket and supporting arbor or mandrel. Exhibits G and J simply show other familiar constructions of chuck, similar to that disclosed in Exhibits H and K, and may be considered as supplementary to the exhibit in this respect.

X-Q. 20. Your purpose in referring to Exhibits F, G, H, J and K, as I understand you, is to show examples where tapered socketed chucks have been carried on plug arbors; is this correct?

A. Yes, and to bring out as well the essential cylindric form of such chucks and the concentric arrangement of their taper sockets with their cylindric parts and jaws, for the purpose of disclosing the fact that these chucks are not alone taper socketed, like the Edison phonogram, but were cylindric parts having taper sockets concentric with their cylindric surfaces, like the Edison phonogram.

X-Q. 21. And the several exhibits referred to in my question all disclose this practice as I understand you?

A. Yes.

X-Q. 22. And you consider it necessary in order that



the court may understand this practice that all of these exhibits should be relied on; is that correct?

A. I consider it desirable, and to that extent necessary.

X-Q. 23. How old was the practice of mounting tapered live or dead centers in taper-socketed live and tail spindles, respectively, and of carrying taper-socketed chucks on plug arbors?

A. I have no means of knowing, further than what the books show in this regard, as to dates, prior to my own experience, which began about the year 1883. This practice was old at that time; and the references to the Scientific American of 1876 and 1877, from the cuts of which Exhibits K and J were taken, indicates that the practice was well known at that date. The supporting of live and dead centers in the live and tail spindles of lathes must be almost as old as the lathe itself as a machine tool. Chucks were undoubtedly a later development, but it is safe to say that they also date back several generations, and it is altogether likely that the practice of mounting chucks upon taper plug arbors fitted to the tapered socket of the lathe spindle is as old as the history of chucks themselves.

X-Q. 24. Do you find any instance in the prior art where a phonogram record or blank has been tapered on its bore and engaged with a tapered mandrel, so as to rotate by friction?

A. I find in the Tainter patent No. 375,579, filed July 7, 1887, and granted December 27 of that year, a phonogram blank frictionally held upon a taper mandrel, so as to rotate therewith by friction. This phonogram blank did not have a taper bore, and in this respect the prior art does not disclose the construction you refer to in phonogram blanks or records, so far as I am aware.

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X-Q. 25. So far as the prior art is concerned, it was a new suggestion, then, to make a phonogram record or blank with a tapered bore?

A. Confining attention strictly to phonogram records or blanks, it was.

X-Q. 26. This includes, of course, graphophone records or blanks, or other cylindrical records or blanks for use with talking machines?

A. Certainly, I make no distinction between the products of different makers in this respect, but understand the word phonogram record or blank to cover such article wherever found or whatever called in the trade.

X-Q. 27. Referring to the Tainter patent No. 375,579, this patent shows a cylindrical mandrel having a tapered shoulder at one end for engaging the edge of a cylindrical phonogram record or blank, does it not?

A. Yes.

X-Q. 28. Having reference to the Tainter patent No. 341,288, this patent shows a phonogram record or blank having a cylindrical bore and engaging a cylindrical mandrel, does it not?

A. Yes.

X-Q. 29. Do you know whether this construction was adopted on the graphophones which were actually used?

A. No.

X-Q. 30. In order that a cylindrically-bored phonogram blank or record might properly engage a cylindrical mandrel the bore would have to be made with great accuracy, would it not?

A. That would depend quite largely on the character of the phonogram blank or record. If made like complainant's hard soap record with a bore fitting the mandrel throughout its length it undoubtedly would. If made like defendants' elastic celluloid records, which en-



gage the mandrel only at their extreme end edges, it would not. In this latter case the elasticity of the thin edge of celluloid would cause it to conform to a cylindric mandrel, even if the latter were somewhat larger than the bore of the phonogram blank, or even if the latter was bored out not quite cylindrically.

X-Q. 31. Would there be the necessity for such close fitting with a taper-bored record or blank engaging a tapered mandrel as with a cylindrically-bored record or blank engaging a cylindric mandrel?

A. Probably not. However, the fitting required in such a case for a celluloid record like that of defendants' is not so close but what it is perfectly practicable, and I understand that defendants have in contemplation and have patents pending upon a phonographic machine the mandrel of which is perfectly cylindric, and is designed to support celluloid records, such as those at present made by defendants, simply by the close frictional grip of the inturned end edges of the celluloid tube upon the cylindric mandrel.

X-Q. 32. Having reference to the machine to which you refer, is the mandrel cylindrical throughout, or is it provided with two cylindrical portions of different diameters?

A. I have not seen the machine, but understand that it is provided with two cylindrical portions of different diameters corresponding to the diameters of the opposite ends of defendants' phonogram record blanks as now made. This enables the same records to be used equally well upon the tapered mandrel of the ordinary form of phonograph or upon the cylindric mandrel of the machine which defendants propose to manufacture.

X-Q. 33. Reverting again to the Tainter patent No. 341,288, could a cylindrically-bored record or blank, as

described therein, be as readily removed from a cylindrical mandrel as a tapered blank or record from a tapered mandrel?

A. Probably not.

X-Q. 34. And I understand that at the date of this Tainter patent the suggestions to which you previously referred of mounting tapered live and dead centers in taper live and tail spindles and of mounting taper-socketed chucks on plug arbors were well known and of common knowledge?

A. Yes.

X-Q. 35. Do you find, prior to the patent in suit, any instance in any art—analogueous to phonographs or not—where taper bored work has been carried on a taper mandrel by friction, the work having a cylindrical outer surface concentric with the bore?

A. That depends on what you call "work." Almost all chucks of the character I have referred to, and such as are shown in the exhibits, have a cylindrical outer surface concentric with the bore, and, as before pointed out, are carried on a taper mandrel by friction. The dental-polishing tool of Locke, shown in patent No. 170,178, has a polishing sleeve D of sand paper or the like, which has a tapered bore and is supported on a taper mandrel by friction. This sleeve has a conical outer surface, which is one form of cylinder in the broad sense of that term. Moreover, every twist drill almost—and a great variety of other tools—possesses essentially all of the elements of the construction you assume, considered with respect to their ordinary mounting, which is by the insertion of a tapered shank on the drill in a taper socket in the supporting spindle of the lathe or drilling machine. The outer surface of twist drills is cylindric and is perfectly concentric with the tapered shank, and, as I have previ-



ously pointed out, it is a mere reversal to make the taper socket on the driven part or work and the taper spindle on the mandrel instead of placing the taper socket in the spindle or mandrel and the interfitting tapered shank on the driven tool or drill.

X-Q. 36. By "work" in my question I mean a body having a tapered bore and a cylindrical outer surface, the latter being operated upon by a tool with respect to which the work is rotated; and by "cylindrical" in my question I mean that the word should be taken in its ordinary sense as referring to a form in which a section at any point is a circle of the same diameter. With this understanding, kindly answer my previous question.

A. There does not appear to be present in the illustration of the prior art in evidence any example which exactly meets the conditions of your question as thus laid down. In this connection, however, I should perhaps explain that while the definition of "work" above given may apply to complainant's records, which are in fact operated upon by a tool both in turning down their outer surfaces to a cylindric form, and in cutting the sound record upon them, I do not understand that it would apply to defendants' celluloid records, the outer cylindric surface of which is never operated upon by any tool, but which, on the contrary, itself acts as a tool to vibrate the stylus, and consequently the diaphragm of the phonograph, and never acts or is acted upon in any other way.

X-Q. 37. In effecting reproduction the action of defendants' records is the same as Edison records, is it not?

A. Yes.

X-Q. 38. Is it your understanding that the recording tool of modern phonographs is sharp pointed?

A. I do not know just what the form of point is, as I have never examined one for the purpose of ascertain-

ing. I do know, however, that it is a cutting tool and that it cuts out a chip of the wax or soap record in the recording operation, and I assume that it must be more or less pointed in order to cut. At the time of the patenting of the devices involved in this litigation, moreover, Mr. Edison described in numerous patents the form of recording tool preferred by him, and it was invariably a sharp-pointed tool, as illustrated, for example, in "Defendants' Exhibit Edison Patent No. 393,967," of December 4, 1888. As to whether this is the exact form of recorder at present employed I am not informed.

X-Q. 39. When you stated that the recorder of a phonograph "is sharp-pointed" in your direct examination you had reference to the phonograph as you think it was constructed at the time of the patents in controversy, and not necessarily as it is constructed now?

A. That is correct.

X-Q. 40. Do you know anything about the character of the record formed on modern phonographs?

A. Your question is not quite clear. I have made many of these records myself in using the phonograph, and I have seen hundreds of such records made by other people, and have seen them while they were being made, and I of course know the character of the record so far as ordinary observation will reveal it. I have never examined it under a microscope or with any purpose of determining the exact form of the groove cut, if that is what you have in mind.

X-Q. 41. You do not know, then, what the form of the record groove is in modern phonographs?

A. Not specifically—no.

X-Q. 42. Having reference to the Tainter patent No. 375,579, wherein a cylindrical record or blank is carried on a cylindrical mandrel and at one end is jammed



against a tapered shoulder, do you consider this a desirable construction?

A. No, and I am not surprised that almost immediately it was followed by the tapered bore construction disclosed in the Edison patent. In fact, it would be quite surprising if this tapered bore construction had not been disclosed at the very infancy of the art, as it was, and in one of the very first printed descriptions relating thereto.

X-Q. 43. Does the patent to Birkman add anything to the references found by you in Machine Shop Practice and the Scientific American and lettered A to K inclusive?

A. Only as showing another example of the common use of the tapering socket construction in concentrically supporting various cylindric parts.

X-Q. 45. Referring to the patent to Abbe No. 277,097, you state that "the hub A of the buffing wheel is taper bored." Please refer to the part of the patent describing this feature.

A. There is no description in the specification of this patent as to how the hub is bored, but it is clearly shown in Fig. 1 as bored out upon a taper, and as fitting upon the mandrel or spindle D, which is correspondingly tapered.

X-Q. 46. Is it not a fact that with the Abbe patent the hub is elastic and is cylindrically bored, its elasticity permitting it to be forced on a tapered mandrel? I direct your attention to Figs. 2 and 3 of the patent showing the hub off of the mandrel, and to Fig. 8 of the patent showing a cylindrical mandrel.

A. The hub is described as an elastic hub made of rubber or other material, but I see no reason for assuming that the bore of the hub is not tapered, as it appears to be in Fig. 1. Fig. 3 shows a modified form of the

hub (according to lines 12 and 13, page 1 of the specification), and Fig. 8 shows a modified form of mandrel apparently intended to fit this modified form of hub of Fig. 3, and made cylindric instead of tapering like the mandrel of Fig. 1. As to whether the bore of the hub, as shown in Fig. 2, is tapering or not, it is difficult to determine from that detail, but I should say that it was tapering about as shown in Fig. 1. Undoubtedly the elasticity of the hub would lend itself to firmly gripping the mandrel, but this elasticity appears to be more for the purpose of enabling the rings B which support the spider C to be more readily sprung in place, and it is certain that with the degree of taper shown in Fig. 1 the hub would be held friction-tight on the taper mandrel, if it was not elastic, just as the taper-socketed chucks of defendants' exhibits are held friction-tight upon their tapered supporting arbors.

X-Q. 47. Having reference to this Abbe patent, and bearing the fact in mind that the hubs thereof are made of elastic material like rubber, is it not a fact that if the hubs were provided with cylindrical bores they would, if forced on the tapered mandrel, appear as in Fig. 1?

A. Yes.

X-Q. 48. In view of this fact and of the absence of anything in the specification reciting the character of the bore of the hub of the Abbe patent, is there anything to negative the assumption that that bore is cylindrical and not tapered?

A. The necessity of making the assumption, which is purely an assumption and is not based upon anything in the patent itself, is its own negation.

X-Q. 49. So far as the Abbe patent is concerned, is it possible to say that the bore of the hub is tapered or cylindrical with any degree of certainty?



A. It is possible to say absolutely that the bore of the hub when in place on the arbor is tapered, as shown in Fig. 1. As to whether this tapered form which it possesses in this figure is the result of purposely cutting it to fit the taper mandrel, or is the result of compressing the material of the hub in the act of forcing it upon the taper mandrel it is not possible to say. Taking the patent as a whole, however, in my judgment it discloses and would suggest to the mind of a mechanic the idea of boring out the hub upon the taper to fit friction-tight upon a correspondingly tapered mandrel.

X-Q. 50. But so far as the Abbe patent is concerned, and viewing the hub apart from the mandrel, you cannot say whether the hub is taper bored or cylindrically bored, can you?

A. No.

X-Q. 51. Having reference now to the patent to Locke, this patent, as I understand it, shows a small tapered spindle with a cap of emery paper or analogous polishing material carried by said spindle. Is this correct?

A. Yes.

X-Q. 52. Is this cap conical or cylindrical on its outer surface?

A. It is conical.

X-Q. 53. Is this cap held on by friction, or is it glued on?

A. I understand that it is held on by friction.

X-Q. 54. Having reference now to the Phillips patent No. 70,113, I understand that this patent is referred to for the purpose of showing a spool carried on a tapered shaft. Is this correct?

A. Not merely a spool, but a taper-bored spool car-

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ried on a tapering rotary shaft or spindle or mandrel. This comes pretty near to answering the conditions of X-Q. 35, and does answer it exactly except that the cylindric spool, the bore of which is tapered and made concentric with its cylindric outer surface, is not a piece of "work" within the limits of your definition, which requires that such work shall be operated on by a tool. In other words, while it possesses all of the physical characteristics assumed by the question referred to, it is not subject, in this reference at least, to the operation of any cutting tool, as also assumed by the question.

X-Q. 55. This patent to Phillips then is, in your opinion, as I understand you, as closely related to the suggestion of the Edison patent in question as any of the other references which you have considered. Is that correct?

A. It possesses absolutely every physical characteristic of the improvements set forth in the claims of the Edison patent, *i. e.*, it has a bore tapered throughout its length and a cylindric outer surface concentric with the bore, and in this respect it is as closely related as any of the other references. The art of winding spools is, however, not as closely related to the phonographic art as is the art of turning and lathe work, it having already been pointed out that the phonograph itself is in fact, and except as to its vibratory diaphragm, only a special form of turning lathe.

X-Q. 56. What connection is there between the art of recording or reproducing speech and the art of turning articles in a lathe?

A. The most obvious one that both require the cutting of a chip from a revolving piece of work by a tool which is mounted in a carriage traveling on ways arranged parallel with the axis of the revolving or turning



work, and that both require the provision of a feed screw also arranged parallel with the axis of the turning work and operating upon the carriage so as to move the cutting tool longitudinally of the work as the latter is turned, and as a result of these common physical requirements that the work is turned or cut in the lathe and is turned or cut in the phonograph in precisely the same manner and by precisely the same spiral chip. Indeed, the analogy is so close that, as I have before pointed out, it would be possible with many styles of turning lathe to make a phonograph of the lathe simply by providing it with the particular cutting tool or stylus necessary for producing sound records and with a diaphragm for acting with such stylus in accordance with the sound vibrations of the voice. I am speaking now of the phonograph as used for the production of sound records by the ordinary cutting operation which the patent in suit contemplated and which is actually practiced in the phonographic art.

X-Q. 57. Making the additions to a lathe which you describe, would a satisfactory phonograph, in your opinion, be produced?

A. Not for commercial purposes, for the reason that a turning lathe is not specially designed for this particular work and is specially designed for a great many other kinds of work, and this necessarily modifies the details of its construction from those which would be most useful and desirable in a machine especially designed for producing and reproducing sound records.

X-Q. 58. But for the reasons which you give you regard the art of recording or reproducing speech as analogous to the art of turning forms in a lathe, do you?

A. I most certainly do, particularly in so far as relates to the manner of supporting the piece or part to be

turned upon the spindle or mandrel which turns it. As to this feature of the arts they are not merely analogous, but are, in my opinion, absolutely identical.

X-Q. 59. Referring again to the Phillips patent, which you state is as closely related to the Edison suggestion as any of the other references, kindly point out the statement therein that the bore of the spool is tapered.

A. There is no statement in the specification to that effect, but the statement is made that the shaft F upon which the spool is removably supported is a "tapering shaft," and it is clearly shown to be a tapering shaft in Fig. 5, and this figure equally shows the spool H as closely fitting the shaft throughout the length of the spool, and consequently as having a bore tapering throughout its length.

X-Q. 60. Are spools ordinarily taper bored?

A. They are not at the present day. But as to whether or not they were in the 60s, when his patent came out, I have no information.

X-Q. 61. Upon what did you base your statement in answer to X-Q. 54 that the Phillips patent shows "a taper-bored spool"?

A. Upon the fact that the drawing shows a spool having a hole in it which is noticeably larger at one end than at the other, and which tapers uniformly in its dimensions from the one end to the other.

X-Q. 62. If the spool of the Phillips patent were an ordinary spool having a cylindrical bore and were forced over a tapered spindle or mandrel, would it not present the appearance shown in Fig. 5 of that patent?

A. It would not.

X-Q. 63. Why would it not?

A. Because the wood on the spool would be cracked



and the spool destroyed before its bore could ever be forced to assume a taper form of the degree shown in this drawing.

X-Q. 64. And that is the only reason why you assume that the spool of the Phillips patent is taper bored and not cylindrically bored?

A. I assume that the spool of the Phillips patent is taper bored because the bore of the spool which the patent shows is actually tapering, and because there is nothing in the patent or out of it, so far as I know, which calls for any other assumption, or which tends to negative the fact that the construction of the spool is actually what the drawing shows it to be.

X-Q. 65. As I understand you, if you engage a taper-bored article with a tapered mandrel made to fit the bore you pass the article over the mandrel until the mandrel engages the bore frictionally. Is that correct?

A. That is correct.

X-Q. 66. Now the Phillips patent states that the spool is placed on the shaft "by forcing the latter through the spool axially." Would this be true if the spool were taper bored?

A. This is merely another way of stating the same thing. The one part has got to be threaded through the other, and in order to do this there must be relative movement between them in a direction to bring the enclosing part over the part enclosed. Now whether this is done by holding the mandrel or shaft stationary and passing the taper-bored sleeve or spool over it, or by holding the sleeve or spool stationary and passing the mandrel or shaft through it, is quite immaterial as to the result produced. The shaft F of the Phillips device is made to be removed bodily from its bearings, and can then be pushed

through the hole in the spool, or the spool can be thrust over the shaft, the result being the same in either case.

X-Q. 67. You will notice that the Phillips patent does not state that the shaft is passed through the spool, or pushed through the spool, or even thrust through the spool, but, on the contrary, states that the shaft is "forced" through the spool axially. Now what I want to find out is, if the spool of the Phillips patent is taper bored, what is the necessity for "forcing" the shaft through the spool? Why would it not be sufficient to do as you say may be done, viz., to merely "pass" the shaft through the spool?

A. Inasmuch as it is quite immaterial in this Phillips patent how the parts are brought together so long as they are forced into frictional engagement, it is not to be expected that the words chosen to describe the operation should be selected with any unusual care or nicety as to extreme accuracy in this regard. But whether the operation be described as passing, or pushing, or forcing, or thrusting the shaft through the spool, or the spool upon the shaft, it is the same operation and requires more or less force in order to bring about the necessary degree of friction.

X-Q. 68. As I understand you, then, the expression of the Phillips patent "forcing the latter through the spool axially" does not appeal to you as a particularly apt or accurate way of describing the introduction of a tapered shaft within a taper-bored spool and the subsequent forcing of these parts together to give the frictional grip?

A. On the contrary, that expression happens to be, in my opinion, both apt and accurate. All that I intended to suggest by my previous answer was that inasmuch as the character of this operation is quite immaterial to the



Phillips machine, or rather quite incidental thereto, it would not be surprising if in this respect language had been used which was somewhat inaccurate. In other words, in a detail of this kind no conclusions can be predicated upon the wording in which the description of some purely incidental portion or function of the machine described is expressed.

X-Q. 69. In the bobbin-winding device of the old Wheeler & Wilson No. 8 sewing machine, as I understand you, a cylindrical bobbin having a cylindrical bore is carried on a taper spindle?

A. In the only one of these machines which I ever personally examined the bobbin was quite narrow, only about five-sixteenths of an inch in width, and I was unable to determine from this bobbin, which was somewhat worn with long use, whether its bore had ever been intentionally tapered or not. Apparently at the time I saw it it was tapered from the middle toward each end, *i. e.*, it was worn out to a larger diameter towards each side of the bobbin, as by being repeatedly forced upon the tapered spindle indiscriminately from either side. The taper of the spindle was quite marked, and I should say that it increased in diameter at least one-half within its length, which was about three-quarters of an inch.

X-Q. 70. Did the bobbin turn on the spindle in this old Weeler & Wilson sewing machine?

A. The bobbin normally and in the operation of the machine was not placed upon the spindle, but within a rotary carrier or shutter, the central aperture or bore of the bobbin being unoccupied. The spindle I refer to was a rotary spindle mounted in close proximity to the driving wheel in such manner that it could be thrown at will into contact or driving connection therewith. The object of

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this spindle was to support the bobbin in winding the latter full of thread preliminary to placing it in the shuttle, and in this winding operation the bobbin did not turn on the spindle, but was thrust friction tight thereon so as to revolve with it, substantially as the spool in the Phillips patent is thrust on the shaft F.

X-Q. 71. When did you examine this Wheeler & Wilson machine?

A. About a month ago, just before I gave my first testimony in this cause.

X-Q. 72. Having reference now to the construction of hour hands for clocks which you refer to, how long have you been familiar with that practice?

A. I am unable to give any particular dates in this regard. I am satisfied in my own mind that the practice has been followed to a greater or less extent for decades.

X-Q. 73. Did you personally know of this practice prior to the dates of the patents in suit?

A. I am unable to swear that I did.

X-Q. 74. Is not the rotating sleeve of a clock movement a cylindrical sleeve?

A. It certainly is sometimes.

X-Q. 75. Did you ever know of the sleeve of a clock movement for receiving the hour hand being made with a taper?

A. I believe that I have, but when it comes to making any definite statement of when or where I find that my impressions are too indefinite to do so. I have never had any particular experience in clock or watch making.

X-Q. 76. You have already stated that in your opinion the art of recording or reproducing articulate speech is analogous to the turning of forms in a lathe, and in order that we may include all the references to which you



allude in considering the Edison patent No. 382,418 I ask you this question: Is the art of recording or reproducing articulate speech, in your opinion, or more specifically, is a phonograph, in your opinion, analogous to the art of making buffer wheels, the art of spooling thread, the art of making dental polishing tools, the art of winding bobbins in sewing machines, and the art of mounting the hour hands of clocks, in all of which arts you have gone in search of references?

A. In so far as these arts all involve common mechanical principles and well understood mechanical constructions in supporting a piece to be turned or revolved upon a mandrel or cylinder, by which it is to be revolved, these arts are all analogous, and a mechanic working in the one may be expected to borrow from and use the mechanical expedients commonly employed in the other. In other words, as to broad features of mechanical construction that have nothing in particular to do with the distinguishing characteristics which cause one line of industry or effort to be distinguished from other lines as a special art, the entire field of mechanics may be regarded as one art, as a common field in which the usual expedients and practices and operations of mechanics may be expected to be utilized without invention or originality. And I have already pointed out that the alleged improvement of this Edison patent to which you have referred has absolutely nothing in the world to do with the art of reproducing speech so far as the particular requirements of that art are concerned. The reproduction of the recorded speech and the recording of the speech to be reproduced would be accomplished in precisely the same way and with precisely the same effect and result if the wax-like recording tablet were

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supported in the special lathe or phonograph in any other of the dozens of different ways in which work is ordinarily supported in ordinary lathes. And, on the other hand, the same method of supporting work to be turned by providing the work with a concentric taper bore to fit upon a correspondingly tapered mandrel or cylinder is equally valuable, and, as we have seen, is commonly employed throughout the mechanical arts generally, and especially in the art of turning cylindric work by the use of lathes. This mechanical expedient is the same in whatever field it is used, whether in phonographic work, or in ordinary lathe work, or in any other line of industrial effort; its mechanical characteristics are the same in all cases, its advantages are the same, and it solves the same problem in each case in the same way. I therefore cannot see that in this controversy it makes a particle of difference where or in what relation the taper-socketed construction involved is found, or that its bearing upon the claims of this Edison patent can be changed by its relation to other mechanical devices in connection with which it is found, no matter how remote from the phonographic art these related devices may seem.

Adjourned till Thursday, April 10, 1902, at 10 o'clock A. M.

April 10, 1902. Parties met pursuant to adjournment. Present as before.

X-Q. 77. Having reference now to Edison patent No. 382,462, in connection with which I understand your position to be that defendants do not use a record made of wax-like material, it is a fact, is it not, that the several waxes referred to in the Century Dictionary, from which you quote, differ considerably in their physical properties, such as their appearance, consistency, odor, color, and in



their actions under the effect of specific temperature changes, as well, of course, as in their chemical compositions?

A. This is certainly true as to those waxes with which I am personally familiar, and I presume it is also true with regard to the others, although I know practically nothing about their chemical composition.

X-Q. 78. Some waxes are also harder than others, are they not?

A. Yes.

X-Q. 79. Do you regard the term "waxy" as being synonymous with "wax-like"?

A. I do not know whether it is entirely synonymous or not. The term "wax-like" is not defined in any of the dictionaries, so far as I was able to discover. To my mind, however, the two terms have much the same significance and might ordinarily be used interchangeably.

X-Q. 80. When you referred to the word "waxy" as being a "similar term" to "wax-like" did you use the term interchangeably?

A. I used the term "waxy" as being the nearest term to wax-like which I could find in the dictionary. If you mean to inquire as to whether I intended to say that the term "wax-like" could be interchanged with the term "waxy" as to the dictionary definition in connection with which I used the expression, my answer is that, while possibly this definition may not be comprehensive of all properties which might be called wax-like, the properties which it does mention might ordinarily be expected to characterize a substance which would be called "wax-like."

X-Q. 81. The definition of "waxy" which you quote may then, as I understand you, be applied to wax-like?

A. Yes.

X-Q. 82. Do you agree with this definition from the Century Dictionary as defining your idea of a wax-like material?

A. Yes.

X-Q. 83. A wax-like material, then, is one that resembles wax or putty in appearance. Is this so?

A. Yes; that is to say, that is one of the qualities which might be expected to characterize a wax-like material.

X-Q. 84. And a wax-like material is one that resembles wax in softness?

A. That also is a quality of resemblance which may be expected to characterize a wax-like material.

X-Q. 85. And in plasticity?

A. The same answer holds as to this quality.

X-Q. 86. And in adhesiveness?

A. The same answer holds as to this quality also.

X-Q. 87. And, I presume, in physical structure?

A. I see nothing about physical structure in the definition, and I am not sure that I know what you mean by it, but inasmuch as wax-like or waxy means in general "resembling wax," I should say that a similarity in any or all of the properties or qualities of wax might be expected to be found in a greater or less degree in wax-like material.

X-Q. 88. And, under your definition, a wax-like material is one that resembles wax in pliability?

A. That quality might also be looked for in a wax-like material.

X-Q. 89. And finally in being yielding or impressionable like wax?

A. The same answer holds as to this quality also.



X-Q. 90. Do you regard putty as wax-like under this definition?

A. Somewhat.

X-Q. 91. What reservation, if any, do you make in your answer?

A. I do not know that I would be able to state exactly what the extent of this reservation is or should be. Putty is not wax, and while it may be used in the same manner under certain circumstances, each has its own peculiar qualities which fit it for different characters of use. To whatever extent they possess qualities in common putty is wax-like, and wax is putty-like. To whatever extent they possess separate qualities wax is not putty-like, and putty is not wax-like.

X-Q. 92. Do you regard putty as being wax-like?

A. To a certain extent, particularly in its original or plastic condition and before it sets. Putty that has stood a long time has very few wax-like characteristics.

X-Q. 93. One of the properties of wax is that it presents, under normal temperatures, a smooth, unglazed surface. Is this not also true of celluloid?

A. Yes, and of almost every other material which might be mentioned.

X-Q. 94. Please mention one material which in this respect is as closely allied to wax as celluloid.

A. I do not know what you mean by "as closely allied to wax as celluloid" as you use it in this connection. In the respect mentioned, *i. e.*, as to presenting a smooth, unglazed appearance at ordinary temperatures, I may mention off-hand wood, iron, stone, gutta-percha, unglazed pottery, vulcanite fibre, leather, paper and bone.

X-Q. 95. These several materials which you have mentioned are then, in your opinion, so far as the charac-

ter of the surface is concerned, as wax-like as celluloid. Is this correct?

A. The question of whether they are "as wax-like" is one of degree, which it is difficult to determine or express by any general statement, and probably not without an investigation for the purpose of making the comparison. In the respect mentioned in your previous question, *i. e.*, of presenting under normal temperatures a smooth, unglazed surface, I should say that these materials in general present quite as wax-like an appearance as celluloid, or quite as unwax-like, for it may be put as well in that way as the other, in my judgment.

X-Q. 96. How would you distinguish, so far as the question of appearance is concerned, between the sheet of celluloid and sheet of white paraffin wax?

A. If I was unable to judge except by appearance, *i. e.*, if I was unable to feel of the materials or to smell of them, and there was no difference in color, it is quite possible that I might not be able to distinguish them, and equally possible that I might not be able to distinguish either from a sheet of paper, or of rubber, or ivory.

X-Q. 97. If, so far as appearance is concerned, you could not distinguish a sheet of celluloid from a sheet of wax, then in this respect celluloid instead of being unwax-like, as you before stated, is wax-like?

A. If the assumptions of your question are correct, all of the substances mentioned, to wit, paper, rubber, ivory and celluloid, may be said to be wax-like, or ivory-like, or rubber-like, or celluloid-like in appearance—in other words, assuming a peculiar kind of wax different in appearance from the prototype of that kind of material, to wit, beeswax, and assuming that the color distinction was so far obliterated between this particular kind of wax



and celluloid, or ivory, or rubber, or paper, so that to the eye they all presented the same appearance to the extent that it was impossible to distinguish one from the other, then either might be said to present an appearance like either or all of the others, and in this respect, and under these assumptions and circumstances, the celluloid would be wax-like instead of unwax-like, as you stated.

X-Q. 98. Another property of wax is that it softens by the application of heat and hardens by the application of cold. Is this true of celluloid?

A. It is true of almost every material, or at least of a very large proportion of known materials, including celluloid.

X-Q. 99. Is it true of wood, stone, unglazed pottery, vulcanite fibre, leather, paper and bone, which you refer to in your answer to X-Q. 94 as materials presenting the same appearance as wax?

A. It is true of stone and pottery of the list you have mentioned, and if the heat be a moist or steam heat it is true of wood.

X-Q. 100. So far as the property of becoming soft under the effect of heat, do you regard stone, wood and unglazed pottery as analogous to wax as celluloid is analogous to wax in this respect?

A. Not to the same degree.

X-Q. 101. Is ivory softened by heat?

A. Not by a dry heat, so far as I know.

X-Q. 102. At what temperature does celluloid become plastic?

A. Somewhere between 250 and 300 degrees Fahrenheit.

X-Q. 103. At what temperature would the hardest wax of which you have knowledge become plastic?

A. I have no information in this respect except as to beeswax, which becomes plastic at about 80 degrees Fahrenheit.

X-Q. 104. In the Bell & Tainter patent No. 341,214 the specification refers to a "waxy or amorphous and slightly cohesive substance." Does not this indicate that at the date of the patent in suit waxy or wax-like in this art had reference to the structure of the material used for the record or blank?

A. If by "structure" you mean those characteristics which rendered the material peculiarly amenable to the cutting operation, which was the keynote of the improvements made by Bell & Tainter in this art, I think that it does.

X-Q. 105. Is it possible to make a record on the celluloid blank by a cutting operation?

A. I do not understand that it is except where some special chemical treatment is first given the surface of the celluloid blank in order to so change its ordinary hard and brittle character as to give it a surface sufficiently soft and wax-like to be cut.

X-Q. 105. If, then, the surface of the celluloid blank is first made sufficiently soft as to be cut, the celluloid blank in that case is wax-like. Is that your idea?

A. Not so. My idea is that the surface of the celluloid blank is first so chemically treated that it ceases to be celluloid during the time that the cutting operation is proceeded with. My understanding is that the chemical treatment consists in applying a solvent to the exterior of the blank, which solvent changes its characteristics for a time, and long enough to permit the cutting operations to be followed, but afterwards evaporates and permits the celluloid to return to its natural hard and brittle condition.



X-Q. 106. And I understand you that during the time the cutting operation is being performed the celluloid is temporarily, so to speak, converted into a wax-like material. Is this correct?

A. Yes, wax-like in the respect that it can be cut.

X-Q. 107. And as I understand you, the reason why above all others that you regard celluloid as not being a wax-like material is that in its normal condition a phonographic record cannot be cut thereon. Is this so?

A. No; the principal reason why I regard celluloid as not a wax-like material is that it is so obviously lacking in those characteristics which distinguish waxes from other substances that, except for the selfish purposes of a complainant in this sort of controversy, no one in the wide world would ever think of calling it a wax-like material. And I have particularly stated that even should it prove possible by some form of apparatus to cut a sound record upon a celluloid phonogram blank in its normal hard and shell-like condition, that fact would have no effect whatever on my conclusions in this regard. For aught I know it may be possible by some form of apparatus, and perhaps with the aid of a diamond, to engrave a sound record upon a glass phonogram blank; but if that should prove to be the fact it would not follow that the glass was a wax-like material, and no more would it follow that if it should prove possible to cut a sound record upon a celluloid blank the celluloid would therefore be a wax-like material. The point is not that wax can be cut, and that celluloid or glass cannot be cut, but rather that wax is noteworthy for certain recognized characteristics which readily lend themselves to the cutting process contemplated by the patent, which process was and still is actually employed by the patentee; whereas celluloid is a



substance noteworthy for the opposite characteristics which render it difficult to cut and tend to rigidly preserve against cutting or wear whatever form it originally was forced to take, these unwax-like characteristics being those which render the celluloid particularly amenable to defendants' process of forming the record by heat and pressure instead of by cutting.

X-Q. 108. But, as I understand you, your view is that celluloid is not wax-like because it cannot be readily cut, in which respect you distinguish it from a wax-like material. Of course I refer to celluloid in its normal condition.

A. That is not my position, and I regret if my statements in this regard have been so lacking in clearness as to mislead you into that impression. My reason for holding that celluloid is not a wax-like material is basically that celluloid does not possess those characteristics which are the noteworthy qualities of wax, and is in fact so entirely different from wax that it is never classified or in the remotest degree associated in the sciences and arts, or in practical life, or in the definitions of the authorities, with wax or wax-like substances. Then when I come to inquire into the reason for the use and specification of wax-like material in the patent in suit I find that it obviously results from the demand, for the purposes of the patent, of one certain characteristic in particular which is peculiar to wax, *i. e.*, that of softness and plasticity at ordinary atmospheric temperatures, which enables records made of wax or wax-like materials to be handled and made use of in the manner contemplated by the patent and necessitated by the practices of the art as it existed at the date of the patent. But even considering this characteristic or quality of wax or wax-like materials by



itself alone, and without calling into question other qualities which are ordinarily understood to characterize wax, I find it to be lacking from the celluloid used by defendants to a noticeable degree. In other words, celluloid is not only unwax-like considered generally and with respect to the sum total of characteristics which would naturally be looked for in a wax or wax-like material, but is lacking even in that one particular characteristic of wax or wax-like material which it is evident the device of the patent necessarily contemplated. And this is a noteworthy fact in this discussion, for it is difficult to mention any materials which have not some characteristic in common and which are not as to one or other of their physical properties so similar as to be like one another, while on the other hand the fact that materials differ from each other so as to be called by different names and subjected to different uses necessarily implies that however much they may be alike they are also unlike in some particulars. So that in comparing any two materials for the purpose of determining their likeness or unlikeness fairness demands not only a comparison of the distinguishing characteristics of the materials considered generally and as a whole, but a comparison of those particular characteristics which are essential to the peculiar use in respect to which the comparison is instituted. It is to this double test, therefore, that the question of whether celluloid is a wax or wax-like material should be subjected in this controversy, and it is to this double test that I have subjected it, with the result of finding that celluloid is not only not a wax-like material in the general summing up of those qualities which distinguish it, but also is not a wax-like material in respect to that essential peculiar quality or characteristic which the wax-like material of the patent must possess, *i. e.*, the quality which

lends itself readily to the cutting process of forming sound records and of preparing the surfaces of record blanks for the subsequent cutting of the record thereon.

X-Q. 109. What I am trying to find out, if it is possible to do so, is your position as to why celluloid is not wax-like. In considering the Edison patent in question you refer to patents to Tainter, to Bell & Tainter and to Edison; you also refer to the Century Dictionary, and you state that you have consulted half a dozen other dictionaries and technical works for the purpose of ascertaining what, in your opinion, Edison meant by the expression "wax-like" in the patent in question. As a result of this search you state that your understanding of the expression "wax-like" is "a material having those wax-like qualities which render it capable of being readily cut or engraved upon the record," or, as you also express it, "a material of such wax-like or waxy characteristics as will enable it to properly undergo the cutting operation by which the sound record is engraved," etc. Do you still adhere to this conclusion as a proper definition of your understanding of a wax-like material, or have you concluded to alter that definition?

A. I still adhere to whatever I have said in regard to wax or wax-like material in this respect, but I have nowhere defined "a wax-like material" in the way which you have stated. I have defined "a wax-like material" most definitely by the definition of the Century Dictionary of the word "waxy," as I have been unable to find therein the term "wax-like." This definition I repeat:

"Resembling wax or putty in appearance, softness, plasticity, adhesiveness, or other properties; waxy; hence pliable; yielding; impressionable;"

and I have pointed out that celluloid obviously does not meet this definition. Further on I have defined what I



understood to be *the* wax-like material referred to by Mr. Edison, and have stated that this particular wax-like material which Mr. Edison specifies in his claims meant, in my judgment, particularly a material having those wax-like qualities which rendered it capable of being readily cut or engraved to form the record, and I have compared celluloid with this particular wax-like material and found that it does not correspond with the definition.

In other words, I have first considered the term "wax or wax-like material" generally and with respect to its generally understood meaning in the art, it being noticeable that Mr. Edison does not define in any way what he means by such material, or what particular wax-like characteristic he considered essential, assuming that he did not consider all wax-like characteristics as essential to his material. And then, making this assumption that he did not intend to be limited to all wax-like characteristics, I have endeavored, by a consideration of the general state of the art at the date of the alleged invention, to discover what wax-like characteristic it was which in particular he was seeking to cover, and to which alone he intended to be limited when he specified in his claims "a wax or wax-like material" if he did not intend to be limited to all of the characteristics which such general term would imply. And as a result of this two-fold consideration, the first limited strictly to those facts determinable within the four corners of the patent itself, and the second being outside of the patent and giving it every advantage of the most liberal interpretation to which I could conceive it entitled, I have inevitably been brought to the conclusion: (1) that celluloid is not a wax or wax-like material as ordinarily defined, because it does not resemble wax in softness, plasticity, adhesiveness, or other properties, and because it is not waxen, pliable,



yielding and impressionable like wax; and (2) that celluloid is not the particular wax or wax-like material set forth in the claims of this patent, because it does not possess even that one wax-like quality which Mr. Edison may be perhaps credited with having had in mind, to wit, that which rendered it capable of being readily cut or engraved to form the record.

X-Q. 110. I quote from your deposition:

"And this I understand to be what Edison meant in the patent under consideration when he claimed his phonogram blank or phonogram 'constructed wholly of wax or wax-like material,' *i. e.*, a material having those wax-like qualities which rendered it capable of being readily cut or engraved to form the record, as distinguished from being simply indented like the old tin-foil record of the early phonograph."

By this did you mean that the claims of the patent in suit include any material having the wax-like quality which permits this result to be accomplished, and if not, what did you mean?

A. I take it that you are asking me to define the widest scope which may be given to the claim of this Edison patent, regardless of the particular considerations in issue herein. As to what the words which you have quoted from my deposition meant in the connection in which they are used I am satisfied to leave it to the court to determine whether they clearly and definitely express their meaning or not. And my conclusion which followed those words and resulted from the consideration connected with the use of those words is, as repeatedly stated, that celluloid is not a wax or wax-like material within the limits of any definition which could fairly be given to them in the patent in controversy. As to whether other materials, not involved in this controversy and to which no attention has been heretofore given,



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would be included within a fair definition of wax or wax-like as used in this patent it is impossible to make any direct answer or to speak definitely except by a consideration of the specific materials, and perhaps after an investigation of their qualities. I do not understand that any material which can be "readily cut or engraved upon the record" would necessarily be included within the definition, for with regard to some materials which in all probability can be readily cut or engraved upon the record it is obvious that the words "wax or wax-like" are not applicable to them, no matter in what sense such words be considered. For example, lead is a material which I should expect would be capable of being readily cut or engraved upon the record, and yet by no stretch of imagination can lead be called a wax-like material. And I have no doubt that numerous other materials might be mentioned by those who are particularly familiar with this art which would be capable of being readily cut or engraved upon the record, and so I should not consider that simply because not possessed this quality a material would fall necessarily within the definition, although, as I have before stated, I do regard the words of the claim "wax or wax-like" as necessarily and unavoidably demanding this quality. In other words, I cannot profess to lay down a hard and fast rule which can be used as a test to determine exactly what materials do and what materials do not fall within the meaning of the term "wax or wax-like" as used in the claims of this patent. But I can only point out certain limitations which do appear to be clear and reasonable, and which suffice, for the purposes of this discussion, to determine the question of materials which this discussion involves.

X-Q. III. What, then, is your definition of a wax-like material?

A. A material resembling wax, more particularly a material resembling beeswax, which is the particular wax from which all other waxes take their name, as I understand it. Resembling or having the qualities of beeswax.

X-Q. 112. In what respects must a material resemble wax, or, more specifically, beeswax, in order to be wax-like, for the purposes of the patent under discussion?

A. That I am unable to state, and that the patent does not define. In so far as the patent itself sets forth, there is no wax-like quality which may be omitted. Chemically the patent refers to the material intended as a hydrocarbon, but if it is to be limited to that chemical composition, then complainant's soap records are not a wax-like material within the meaning of the patent. In respect to its mode of manufacture the material is described as one which can be melted so as to be capable of being cast in a mold. But if it is to be limited to this definition, then in this particular also celluloid is not within the meaning of the term, for I do not understand that celluloid can be melted or cast into mold. Going outside of the patent, I have determined to my own satisfaction, as before stated, that one of the wax-like characteristics which is necessarily implied by the term is a wax-like softness at ordinary temperatures by which the material lends itself readily to the cutting operation by which the sound record was produced at the date of the alleged improvement of the patent in suit. But as for definitely establishing the metes and bounds of the term in all respects I am quite as much at a loss to do so as was complainant's expert, when in undertaking to define the term "wax or wax-like" he specified qualities which I have pointed out were possessed by entirely unwax-like materials, such as glass and rubber, to quite as noticeable an extent, perhaps, as they are possessed by wax.



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X-Q. 113. Is celluloid a hydrocarbon?

A. Yes, in its pure form.

X-Q. 114. If a material has no wax-like quality omitted, as you state in your answer to X-Q. 112, can it be anything else than wax?

A. I should say not.

X-Q. 115. Do you understand that the use of the expression "wax-like material" by Edison contemplates the employment of material possessing some properties in common with wax, but not other properties?

A. I do, and when I stated that the patent did not contemplate the omission of any of the qualities of wax, or to quote my words, that "in so far as the patent itself sets forth, there is no wax-like quality which may be omitted," I meant merely that there is nothing in the patent itself which indicates any particular wax-like quality which may be omitted. Obviously, as I have pointed out, the very use of the term wax-like presumes some difference in the material from what would ordinarily be called a wax.

X-Q. 116. Do you know of any instance in the prior art where a phonographic record or blank has been made of material having the same coefficient of expansion throughout, that material being sufficiently smooth to receive an accurate record, stiff enough to make the record self-supporting, and durable enough to give a number of reproductions without objectionable wearing of the record?

A. No.

X-Q. 117. Would not a celluloid record be included in this definition?

A. Yes.

X-Q. 118. You state that among other uses to which

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celluloid has been put the manufacture of imitation amber is included. Is amber a wax?

A. If I remember correctly, amber is a fossil gum. I am not very certain of its characteristics other than those which it presents in ordinary use, and these characteristics are not wax-like in any way; on the contrary, they are almost as unwax-like as the characteristics of glass, and indeed it is frequently difficult to detect glass from amber. It is hard, brittle, difficult to cut, and polished or glassy in appearance. How it acts under the action of heat I am unable to say.

X-Q. 119. Are the Edison soap records wax-like?

A. They possess many wax-like qualities, although they are not wax-like in chemical composition, or, in other words, are not hydrocarbons, and although they differ quite materially from beeswax. For the purposes of this discussion I should say that they might fairly be called wax-like, but that they would mark about the limit of departure from wax which would come within the definition.

X-Q. 120. Please assume one of the Edison soap records made of the same composition to which it added gradually increasing proportions of an ingredient by which the toughness of the resulting record will be increased and its friability reduced. When would such record cease to become wax-like?

A. I don't know.

X-Q. 121. Do you entertain any doubt as to the possibility of changing the composition of the Edison soap records to increase their toughness and reduce their friability?

A. No.

X-Q. 122. Are defendants' records made of pure celluloid?



A. I understand from what Mr. Philpot said that they are not, or that at least some of them are not. The celluloid is loaded, as it is called, with a mineral matter, which somewhat changes its chemical composition from pure celluloid, although it is difficult to distinguish defendants' records from pure celluloid by their outward appearance and essential characteristics.

X-Q. 123. Assume that in the manufacture of a celluloid composition for use as a phonographic record or blank we add an ingredient to the composition in gradually increasing proportions, so as to gradually reduce the toughness of the resulting record, and gradually increase the friability thereof. Can you state when such records would cease to be celluloid-like?

A. No.

X-Q. 124. If in the first case we gradually increase the toughness and reduce the friability of an Edison soap blank we gradually approximate towards celluloid in this respect, do we not?

A. Yes.

X-Q. 125. And if in reducing the toughness and increasing the friability of celluloid blanks in the second case we gradually approach the qualities of the soap records in these respects, do we not?

A. Yes.

X-Q. 126. And you are unable, as I understand it, to draw any definite line in the assumed case so that wax-like blanks will fall on one side and celluloid-like blanks will fall on the other side?

A. That is correct; I am unable to draw any such line.

X-Q. 127. If it were possible to make a phonograph record on a celluloid blank by an ordinary Edison recorder without any special treatment of the celluloid, and

if by doing so a perfectly legible and satisfactory record is secured, would you still adhere to your opinion that celluloid is not wax-like?

A. I would.

X-Q. 128. And I understand that you are unable to say what qualities of wax may be omitted in a material which, for the purposes of this patent, would be included in the definition of a wax-like material?

A. That is true.

X-Q. 129. How are the original celluloid tubes made from which defendants' records are produced?

A. I am informed that a mass of celluloid in a heated and plastic condition is forced by a pressure to escape through a round aperture having a round core which closes the aperture except for a circumferential slit that constitutes the orifice. This is the way in which lead pipes are made, and in which macaroni is made, and I understand that the process of making these celluloid tubes is similar. I am, however, not speaking from my own information in this regard, and may be mistaken.

X-Q. 130. Why, then, cannot celluloid records be molded, if they can be thus forced in a plastic condition around a forming die?

A. I think you will find that I have nowhere said that they could not be molded, but only that they could not be melted and cast in a mold in the manner which the patent contemplates, or as iron castings are made. It is evident that any material which can be made plastic can be molded in the sense that it can be forced by pressure to assume the shape of any vessel which surrounds it. Indeed, the very process which defendants employ in making their records may be said to be a process of molding, since it involves the conforming of the celluloid to



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the surface of the surrounding mold by heat and pressure.

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April 11, 1902. Parties met pursuant to adjournment. Present as before.

X-Q. 131. Is it your understanding that the Edison records are now made by the cutting or engraving process?

A. All of the records which are used commercially or for correspondence purposes in offices are made by the cutting process. As to how the records are made at the factory, the so-called permanent records I mean, those giving musical productions and the like, I am not definitely informed.

X-Q. 132. You are not able to say, then, whether the wax-like material of which the Edison records are made is susceptible of a molding operation for making the records from a matrix or die?

A. I have no definite information on this point, but can see no reason why the material used for these records should not be amenable to some such process as that used by defendants.

X-Q. 133. One of the distinctions which I understand you draw between celluloid and wax is that celluloid cannot be melted. Do you look upon the capacity or quality of a material as permits it to be melted to be a necessary characteristic of a wax-like material in the sense of the patent?

A. As I before stated, I cannot undertake to define exactly just what qualities the patentee contemplated could be omitted from his wax-like material and keep it still within his definition. The capacity of being melted, and in fact of being melted at relatively a very low tempera-

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ture, is one of the most noticeable characteristics of wax, and one which perhaps almost as much as any other characteristic causes wax to be selected in the arts for the various uses to which it is put; but as to whether this should be regarded as an essential quality of the wax-like material which the patent calls for I am unable to state. In this discussion I should be inclined to regard it as an incidental matter at the best.

X-Q. 134. Assume a phonograph blank to be made of a suitable material to carry a record which can be properly and repeatedly reproduced, would the necessities of the phonograph art make it necessary, or even desirable, that the record so made should be capable of being melted?

A. If defendants' celluloid records are satisfactory, and I understand that they are, it is evident that it is not necessary that such records as you describe should be capable of being melted, and even desirable that they should not be capable of being melted, since there is nothing in the process of their manufacture which calls for that operation.

X-Q. 135. Concerning defendants' record you say "it will remain unchanged in any climate or season." Is it not a fact that celluloid gradually changes its characteristic by reason of the evaporation of the camphor?

A. If so I am not informed of it, and cannot conceive of it except as an exceedingly slow process, a matter of years. Certainly I have had celluloid articles in my possession for a considerable number of years, not less than four or five at least, without noticing any such change. It is only a day or two since a hand mirror was broken in my house which had been in my possession, or the possession of my wife, for at least this period, and the back and handle of which were, I believe, of celluloid; but so



far as I could see the mirror was in the same condition as to its back and handle at the time its glass was broken as it was when it first came into our possession.

X-Q. 136. Are you able to state of your own knowledge that defendants' records do in fact remain "unchanged in any climate or season"?

A. I cannot go further than to say that the record which was first shown me about a year ago, when my attention was first called to this litigation, has undergone no change, so far as I could see, in the year or more that has elapsed since that time. I have had no personal experience with these records in any other climate than that of this city, or for any greater length of time than this.

X-Q. 137. Assume that the patent in question contained the definition of wax-like given by complainant's expert. Do you know any instance in the prior art disclosing the invention as thus defined?

A. I know of no instance in the prior art disclosing the precise article which would be defined by the claims under the conditions of your question. I do not admit that there is any invention defined by these claims under any assumption, since records of wax-like material, so far as their outer or active surfaces were concerned, were old in the prior art, and since this alleged invention could not in any case have amounted to more than a change in the degree of thickness of such wax-like surface sufficient to enable the supporting backing previously provided in such prior records to be dispensed with.

X-Q. 138. Is ivory a fibrous material?

A. I do not know, but do not so understand.

X-Q. 139. You do not know, then, whether ivory is a structureless material, or whether it is a material formed of minute tubes?

A. No.

X-Q. 140. Is not "amorphous" in its topical sense synonymous with structureless; without fibre or definite form; molecular?

A. I am not certain that I know what you mean by "topical" in this connection. If I remember correctly, the derivation of the word "amorphous" indicates that its primary meaning is "without form," but my understanding is that the term is almost invariably used in contradistinction to "crystalline" as being without crystal in form.

X-Q. 141. By "topical" in my question I have reference to the sense in which the expression is used by chemists and other investigators in the fields of science. In repeating my question I ask if "amorphous" is not ordinarily used to distinguish that state of physical form as represented, for example, by French or precipitated chalk and natural chalk.

A. I do not know. I am not a chemist, and am not therefore familiar with the exact meaning of chemical terms except in so far as they may have been incidentally involved in my engineering investigations. And I can only repeat that the only sense in which I have ever known the word "amorphous" to be used is as opposed to crystalline. If it is true that a correct definition of the word would deny to an amorphous substance any semblance of structure whatever, whether crystalline or not, I am not aware of it. And when I pass from my own understanding of the term to the dictionary definition I see nothing in the definition to change my own impression. Dictionary definitions are notoriously general, or include various generalities with some attempt at specific definitions, and the specific definition given in the Century Dictionary is "specifically, not crystallized, even



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in the minutest particles." Among the more general definitions I find, it is true, the following:

"Having no determinate form; of irregular shape; having no regular structure; of no particular kind or character; formless; characterless; heterogeneous; unorganized."

X-Q. 142. You do not know, then, whether amorphous is used as opposed to fibrous?

A. No; I never heard it so used.

X-Q. 143. As you understand the word "amorphous" are the Edison records and defendants' records amorphous?

A. I understand that they are. If there is any crystalline formation about the materials of which they are composed I have not discovered it.

X-Q. 144. As you understand the word "amorphous," would an amorphous material be one presenting a smooth surface on which a phonographic reproducer ball might travel without false vibrations?

A. I cannot state whether this would be true with all amorphous materials or not. Glass is commonly regarded as the highest type of amorphous material, and if provided on its surface with a phonographic record would present a smooth surface on which a phonographic reproducer ball might travel, but there is nothing in my experience which would render me capable of forming any definite opinion as to whether false vibrations would result or not.

X-Q. 145. Near the end of your answer to question 6 you refer to what you call the "progress in the development of the art from a wax surfaced cylinder merely to one constructed wholly of wax." Are your remarks in this respect based upon a knowledge of the actual circumstances?

A. They are not. I have no knowledge whatever of this development except that which I gained from a study of the patents relating to this art, all of which, issued prior to 1890 or '91, I have examined more or less carefully. My first actual experience with phonographs and phonographic records and blanks occurred in the winter of 1891-2.

X-Q. 146. I show you now a modern Edison record with a series of parallel, separate ribs on its interior. Is this structure, in your opinion, included in the claims of Edison patent No. 414,761 which you have considered?

A. It is not.

X-Q. 147. Is it your idea that the patent in question is limited to a single construction in which a continuous spiral rib is employed?

A. It is my idea that the patent is limited to a construction in which a spiral rib is employed, it being my opinion that any claim of patentable novelty made in connection with the device of this patent must be predicated upon the provision of such a rib as will enable the record blank to be screwed off from the mandrel about which it is cast. A spiral rib not entirely continuous but interrupted at intervals might equally well accomplish this function; but in any case the rib, whether continuous or not, must be spiral in order to accomplish it. Aside from this one point of novelty which the patent sets forth the expedient described by the patent amounts to nothing more than the cutting away from the interior of the bore of such surplus material as is not necessary to give the proper support for the cylindric blank, and to give the proper frictional grip of the blank on the mandrel, and this expedient, as I have before pointed out, is one generally practiced throughout the mechanic arts.

X-Q. 148. In view of your opinion which you thus



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express, how do you distinguish between the first and second claims of the patent?

A. I don't distinguish between them, but regard them as necessarily meaning the same thing, to wit, the specific device disclosed by the patent.

X-Q. 149. Do you know of any instance in the prior art where a phonogram record or blank has been provided on its bore with cut-away portions forming ribs for supporting the record?

A. No.

X-Q. 150. Do you know of any instance in the prior art where a phonogram record or blank has been provided on its bore with a plurality of ribs or flanges for supporting the record?

A. No.

X-Q. 151. Would you include defendants' records in the latter definition?

A. Yes.

X-Q. 152. Having reference to Dr. Kittler's book, are the armature and commutator held on the shaft by friction?

A. I do not know whether tight frictional engagement is contemplated or not. It is common in such structures to force the parts on a shaft by hydraulic pressure or otherwise, but inasmuch as it is absolutely essential that there shall be no relative rotation between them the frictional engagement is not alone depended upon, but a key is also employed to positively prohibit such rotation, and such keys are shown in the figure from which Exhibit L was copied.

X-Q. 153. Is the shaft of this exhibit tapered?

A. Not visibly.

X-Q. 154. Is not a molding operation one in which

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a material is softened and then changed in its form by means of a mold?

A. That is one form of molding operation.

X-Q. 155. Are not the flanges on defendants' records molded in this sense?

A. I understand that they are, but this is not the sense in which the term is used in the patent in suit, which clearly contemplated the casting of the melted material in a mold in the same way that iron is cast in the foundry.

X-Q. 156. Is there anything in the prior art necessitating this limitation?

A. Not in the prior art of phonographic records, so far as I know.

X-Q. 157. Claims 1 and 3 of the patent in question purport to cover articles of manufacture, do they not?

A. Yes.

*Re-Direct Examination by Mr. Sheridan.*

R-D. Q. 1. In order to clear up any doubt which may exist as to the plug arbor shown in Exhibit E and as to the manner in which taper-bored chucks such as are shown in Exhibits F, G, H, J and K are supported in the lathe by means of an arbor of this kind, will you kindly produce such an arbor and chuck, if you have one at hand?

A. In accordance with your request I here produce a small drill chuck made by the Cushman Chuck Company, of Hartford, Connecticut, and marked "The Hartford No. O, Patented December 16, 1884;" also a plug arbor, such as shown in Exhibit E, having a tapered end which fits the taper of the chuck, so that the chuck may be mounted upon the arbor. The above chuck I have marked "Defendants' Exhibit Taper-Bored Chuck," and the above arbor "Defendants' Exhibit Blank Plug Arbor." My un-



derstanding is that arbors of this character, and such as are shown in Exhibit E, are sold with the cylindrical or blank end—shown at the left hand of Exhibit E—for the purpose of enabling the machinist who buys the arbor to cut the taper upon it himself to correspond with the tapered socket of the live spindle of his lathe. Where the socket in the machinist's lathe is bored on a standard taper, he may purchase instead a plug arbor already tapered to enter the spindle, and I here produce this latter form of arbor and mark it "Defendants' Exhibit Tapered Arbor." The screw nut for forcing off the chuck is not present in this latter form of arbor.

These several exhibits, to-wit, the chuck, the plug arbor, and the tapered arbor were purchased by me yesterday in the open market, and I have no personal information of their date or origin. They are, however, substantially identical with constructions with which I was personally familiar prior to 1887.

Counsel for defendants offers in evidence the exhibits referred to by the witness, and requests the notary to mark them for identification as indicated in his answer.

BRIAN F. PHILPOT, a witness produced, sworn and examined on behalf of defendants, in answer to questions propounded by Mr. Sheridan, testifies as follows:

Q. 1. Please state your name, age, residence and occupation.

A. Brian F. Philpot; forty-four years; Chicago, Illinois. I am president of the Lambert Company, one of the defendants in this cause.

Q. 2. Will you kindly state how long you have been

connected with the Lambert Company, one of the defendants in this cause?

A. Ever since its organization.

Q. 3. Are you acquainted with the methods of manufacturing your celluloid phonograms?

A. I am.

Q. 4. Do you use any wax in the material of which your phonograms are formed?

A. We do not.

Q. 5. As you understand the term "wax-like" do you use any wax-like material, such as is commonly used, in the formation of your phonograms?

A. We do not.

Q. 6. Do you bore out the phonograms in a tapered manner, or are they bored out parallel to the outer cylindrical surface?

A. The bore is parallel to the outer cylindrical surface.

Q. 7. Please state how you bore them out, as plainly as you can.

A. The phonogram is placed in a chuck, which revolves the phonogram, and a cutting tool is run into the end parallel with the outer surface of the phonogram, at one end first, then it is replaced with the other end out, and then the other end is bored of a different diameter also parallel with the outer surface.

Q. 8. What material do you use in the manufacture of your phonograms; or, in other words, of what material are the phonograms composed?

A. Of celluloid; however, I do not think it is what you would call a pure celluloid. It is quite heavily loaded with other material, such as metallic zinc.



Q. 9. Of whom do you buy your material of which the phonograms are composed?

A. From the New York Celluloid Company.

Q. 10. Do you add anything to this material, or take anything away from it before forming it into the phonogram?

A. We do not.

Q. 11. How is this coloring of the outer surface of the phonogram put on?

A. It is an aniline dye. This aniline dye is dissolved and the outer surface of the phonogram blank is bathed in the solution.

Q. 12. Is there an appreciable thickness to this coat of coloring matter?

A. There is not.

*Cross-Examination by Mr. Dyer.*

X-Q. 1. I observe that in the Lambert record the flange at one end is turned at right angles to the surface, while the flange at the other end is curved or bulged outwardly. Why did you adopt this particular arrangement?

A. Our process of manufacturing enables us to make the record more perfectly when made in that way, and the other reason is that it enables us on the right angle end to print the name of the selection.

X-Q. 2. Why does the provision of the curved or bulged flange enable you by your process to make the records more perfectly?

A. The end which you term the "bulge end" is the end by which we center our record blank and matrix in the expander. The base plate of the expander has a concave recess, and the blank being moulded to fit that recess, enables us by putting the moulded end of the blank into

that recess to quickly and perfectly center our matrix and blank in the expander.

X-Q. 3. Why does the provision of a recess in the bottom plate of the expander of the particular shape you have adopted enable you to center the matrix any more readily than if this recess were an ordinary channel with vertical sides?

A. The diameters of the records vary considerably, and if we did not have a concaved or conical-shaped annular recess, we would not be able to center the records perfectly, and if we could not center the records perfectly, we could not get a perfect print or reproduction. Another thing, it would make uneven ridges on the sides of the record.

X-Q. 4. It is a fact, is it not, that Edison records are made with a flat flange at the thick end and a curved flange at the thin end?

A. From my present recollection of the Edison phonogram it is a solid blank with a spiral taper bore, with the thicker end convexed and the thin end having the convex or bulge more pronounced, and not any flange at all on either end.

X-Q. 5. What is your definition of "wax-like"?

A. I should take as my foundation beeswax, or, as I understand it, the original wax.

X-Q. 6. Your belief is, then, that a thing is not wax-like unless it is made of beeswax?

A. I did not say, nor did I mean to imply that, but it should have some of the characteristics of wax in order to be wax-like.

X-Q. 7. How many characteristics of wax should a material have in order to be wax-like?

A. Enough to make it resemble it in character.

X-Q. 8. One of the properties of wax is that it softens



by heat and hardens by the application of cold. Is that a property that a wax-like material should have?

A. Those are properties that are common to glass and iron, and in fact to very nearly everything that you could think of. It would be no more called a property of wax than of glass, lead, iron, or other materials. Putty is a wax-like material that hardens with heat.

X-Q. 9. If putty is a wax-like material in your opinion, then a material in order to be wax-like need not be capable of melting by the application of heat. Is that correct?

Counsel for defendants objects to this line of cross-examination in that the witness is not qualified as an expert in this line of materials, having merely given his opinion from the popular understanding of the word "wax-like."

Counsel for complainant regards his questions as perfectly legitimate, as they seek to bring out the reasons on which the witness bases his opinion.

A. A material might have one or two, or even more, of the properties or qualities of wax, and yet not melt with heat.

X-Q. 10. And that material would be wax-like?

A. It would be wax-like only in those particular qualities in which it resembled wax.

X-Q. 11. I think I understand you now. Your view is that a material may possess some of the characteristics of wax, but not all of them, and be wax-like so far as those characteristics are concerned which are common to that material and to wax. Is that correct?

A. Yes.

X-Q. 12. Do you regard the Edison records as they have been sold since your acquaintance with them as being composed of a wax-like material?

*Deposition of Brian F. Philpot.*

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A. My acquaintance with them is limited to having looked at a very few of them, and I have never examined the material of which they are made.

X-Q. 13. You cannot say, then, whether the Edison records are made of a wax-like material or not?

Question objected to as immaterial and irrelevant.

A. The old Edison records I should say were made of a wax-like material, as they were used for engraving. The new molded records I know very little about—I don't know the material of which they are made at all, having seen very few of them.

X-Q. 14. Is it not one of the important requirements of a suitable material for use for phonograph records that such material should be very smooth and without grain in order that false vibrations of the reproducer, may be eliminated?

A. It is true that the material must be capable of taking a correct reproduction of the sound waves without any holes or ridges other than those which are necessary to produce the desired result?

X-Q. 15. Is not this true of the Edison records you are familiar with which you say are wax-like?

A. As a rule, yes.

X-Q. 16. Is not this also true of defendants' celluloid records?

A. It is.

X-Q. 17. This being so, defendants' celluloid records are wax-like to the extent that they offer a material of the proper structure or make-up for use as a phonograph record. Is this so?

Defendants' counsel objects to the question, first, in that the witness has not qualified as an expert in wax-like materials; and second, that it is the prov-



ince of the court to determine, after all the facts are laid before it as to the materials of which the defendants' records are composed, as to whether they are wax-like in the sense called for by the patents in suit or not; and, finally, that it is not germane to the direct examination, and he hereby gives notice that if the answer be insisted on counsel is making the witness a witness for complainants.

In reply, counsel for complainant again calls attention to the fact that the question is intended solely for the purpose of ascertaining the reasons on which the witness bases the opinion expressed by him that defendants' records are not wax-like. If the witness has this opinion, he certainly has reasons to support it, and those reasons are what the question seeks to find.

A. By the process by which the sound waves are put on an Edison record blank, it would be impossible to put the sound waves on one of our blanks; and, on the other hand, by the process by which we get the sound waves on our material, it would be impossible to get them on a wax blank, so that the processes of getting the sound waves on the two materials are of necessity very different, and the materials when finished are only similar in the fact that they both have sound waves on them.

X-Q. 18. You have not, I think, directly answered my question. In answer to cross questions 15 and 16 you stated that the Edison record and defendants' record possessed an important common characteristic. I asked you if to this extent defendants' celluloid record was not wax-like. Will you please answer this question?

A. I should say that it was more like gold, silver, or copper than wax in that characteristic.

X-Q. 19. Do you regard celluloid as being un-wax-like in this respect?

A. I have very often found in the wax minute holes and imperfections, that I have never discovered in celluloid, that are injurious to the reproduction of sound waves—sometimes also grit and roughness in the wax that I have never discovered in celluloid. When I speak of wax I mean the Edison record blank. In this respect celluloid is un-wax-like. If you mean that a wax phonogram blank is capable of having sound waves recorded on it, and that a celluloid phonogram blank is also capable by an entirely different process of having sound waves put upon it, to the extent that sound waves may be put upon both of them, they are alike, and to this extent only.

X-Q. 20. And both the wax record and the celluloid will give commercially acceptable reproductions; is this correct?

A. Certainly.

X-Q. 21. The Lambert records were designed to be used with standard phonographs and graphophones, were they not?

A. Yes, they can be.

X-Q. 22. But were they not designed for that purpose alone?

A. They were designed with the idea that people owning phonographs or graphophones might be able to use them.

X-Q. 23. You say that the Lambert Company does not use pure celluloid, but uses celluloid impregnated or mixed with other materials. How do you know this?

A. From very often finding these materials in the celluloid itself or loading the material in the tubes which we use, and also from being told so by Mr. Lefferts, the president of the Celluloid Company.

X-Q. 24. Do you consider it possible to make a rec-



ord on the celluloid blank by a phonographic recorder actuated directly by the sound waves?

A. It is absolutely impossible without first changing the condition of the celluloid.

X-Q. 25. And that, I understand, is one, if not the principal, reason why you regard celluloid as not being wax-like?

A. I can't say that that is the principal reason. The principal reason why I regard celluloid as unwax-like is that I know of no characteristic in which they are similar; but so far as your question goes that is one of the reasons.

X-Q. 26. Do you consider it impossible to make a record on the wax-like material employed by the Edison Company by a process analogous to that used by the Lambert Company?

Defendants' counsel objects to the question, first, in that it is immaterial and irrelevant, and, second, in that it is not proper cross-examination on account of not being founded on anything contained in the direct examination.

A. To the extent that moulding is analogous to our process, it can be, as I believe the wax can be moulded.

X-Q. 27. And with your process, as I understand it, the celluloid is not moulded?

A. The celluloid is not moulded, as I understand moulding, but is put into a matrix and under very heavy pressure is forced outwardly against the matrix, thus by pressure making the imprint upon the celluloid.

X-Q. 28. Would it be possible to do this with the wax-like material of the Edison record?

Same objection as before.

A. I do not believe it would be possible to make a

*Deposition of Brian F. Philpot.*

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record by our process upon the Edison phonogram blank.

X-Q. 29. That is not the question. I asked if it would be possible to make a phonographic imprint on an Edison blank by putting it in a matrix, and, under very heavy pressure, forcing it outwardly against the matrix, which I understand is the method which you distinguish from molding.

Same objection.

A. I can't see but my former reply is an answer to this question. By our process you cannot make a record upon an Edison phonogram blank. I have tried to do so, but have always failed, as the wax does not respond under the same conditions that produce a successful celluloid record. I have not limited myself to exact conditions for producing a celluloid phonogram, but have tried by varying conditions to obtain successful results from wax, and have failed. The conditions by which we produce a celluloid blank are, locking the phonogram celluloid blank in a matrix by a top and bottom plate, admitting steam under pressure, which immediately expands the celluloid against the top and bottom plates so as to form a hermetically sealed chamber, while at the same time the celluloid expands until it comes in perfect contact with the inner surface of the matrix. This operation requires a very small fraction of time—by that I mean not to exceed a second; whereas the wax does not form the perfect seal and responds very slowly to heat, and does not give the results obtained under our process.



I, Annie C. Courtenay, a Notary Public in and for the County of Cook, in the State of Illinois, and Special Examiner by agreement, hereby certify that all the proceedings aforesaid were had as stated in the cause named in the caption hereto; that on the 8th day of April, 1902, and subsequent days mentioned in the foregoing deposition, I was attended by Mr. Frank L. Dyer, counsel for complainants, and Mr. Thomas F. Sheridan, counsel for defendants, and by the witnesses Messrs. Henry W. Carter and Brian F. Philpot; that before giving their depositions the said witnesses were by me duly sworn to testify the truth, the whole truth, and nothing but the truth in said cause, and that their depositions were taken down by me in typewriting from their statements and afterwards read over and subscribed by them as and for their depositions in said cause; and that I am not related to or of counsel for either of said parties, or in any way interested in the result of said suit.

In testimony whereof I have hereunto set my hand and affixed my notarial seal this 14th day of April, 1902.

[SEAL.]

ANNIE C. COURTENAY,  
Notary Public for Cook County.

261 And on to-wit: the 24th day of February, 1903, being one of the days of the regular December term of said Court, 1902, in the record of proceedings thereof in said entitled cause before the Hon. Christian C. Kohlsaat, District Judge, appears the following entry to-wit:

Decree, Feb. 24,  
1903.

262 National Phonograph Company,	} In Equity. No. 25789.
Complainant,	
vs.	
Lambert Company and Thomas	
B. Lambert,	
Defendants.	

This cause having come on to be heard on the pleadings and proof and after hearing Richard N. Dyer, Esq., on behalf of complainant and Thomas F. Sheridan, Esq., on behalf of defendants, now on consideration thereof, it is

Ordered, Adjudged and Decreed as follows:

I. That United States Letters Patent No. 414,761 granted November 12th, 1889, to Thomas A. Edison for a new and useful improvement in Phonogram Blanks, being the Letters Patent in suit, are good and valid Letters Patent; that the said Thomas A. Edison was the original and first inventor of the said invention described in said Letters Patent; that the title thereto and to the invention described and claimed therein is vested in the complainant, but that the defendants herein do not infringe said Letters Patent.

II. That the bill be and the same hereby is dismissed without costs to either party as against the other.

264 And on to-wit: the 24th day of February, 1903, came the National Phonograph Company by its solicitors and filed in the clerk's office of said Court in said entitled cause its certain petition for appeal, together with assignment of errors in words and figures following to-wit:



Petition for  
appeal, filed  
Feb. 24, 1903.

# 265 PETITION FOR APPEAL AND ASSIGNMENT OF ERRORS.

UNITED STATES CIRCUIT COURT,

Northern District of Illinois,

Northern Division.

National Phonograph Company,	} In Equity, No. 25789.
Complainant,	
vs.	
Lambert Company and Thomas B. Lambert,	
Defendants.	

To the Honorable the Judges of the Circuit Court of the United States for the Northern District of Illinois Northern Division:

The above named complainant, National Phonograph Company, conceiving itself aggrieved by the final decree made and entered on the 24th day of February 1903 in the above entitled cause, does hereby appeal from said decree to the United States Circuit Court of Appeals for the Seventh Judicial Circuit for the reasons specified in the assignment of errors which is filed herewith, and prays that this appeal may be allowed and a citation granted directed unto the above named defendants, commanding them to appear before the United States Circuit Court of Appeals for the Seventh Judicial Circuit to do and receive what may appertain to justice to be done in the premises, and that a transcript of the record, proceedings and papers upon which said decree was made may be duly authenticated and sent to the United States Circuit Court of Appeals for the Seventh Judicial Circuit.

Chicago, Illinois, February 24 1903.

NATIONAL PHONOGRAPH COMPANY,  
By ISHAM, LINCOLN & BEALE,  
*Solicitors.*

The foregoing petition of appeal is allowed.  
Chicago, Illinois, February 24th 1903.

*U. S. Judge.*

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UNITED STATES CIRCUIT COURT,  
Northern District of Illinois,  
Northern Division.

Assignment of  
errors, filed Feb.  
24, 1903.

National Phonograph Company, Complainant.	} In Equity. No. 25789.
vs.	
Lambert Company and Thomas B. Lambert,	
Defendants.	

Now comes the complainant, National Phonograph Company, by its solicitors, and presents, with the accompanying petition of appeal from the final decree rendered in this cause, the following assignment of errors:

First: The Court erred in deciding that the flanges at the ends of defendants' phonograms are not the equivalents of the ribs of Letters Patent No. 414761.

Second: The Court erred in deciding that defendants' phonograms do not infringe claims 1 and 3 of Letters Patent No. 414761.

ISHAM, LINCOLN & BEALE  
Solicitors for Complainant.

(Endorsed) Filed Feb., 24, 1903, Marshall E. Sampsell, Clerk.

267 And on to-wit: the 24th day of February, 1903, being one of the days of the regular December term of said Court, 1902, in the record of proceedings thereof in said entitled cause before the Hon. Christian C. Kohlsaat, District Judge, appears the following entry to-wit:

Order of Feb. 24,  
1903, allowing  
appeal.

ORDER OF FEBRUARY 24, 1903, ALLOWING APPEAL

National Phonograph Company,	} 25789
vs.	
Lambert Company and Thomas B. Lambert,	

And now comes the complainant by its solicitors, Isham, Lincoln and Beale, and prays an appeal to the United States Circuit Court of Appeals for the Seventh Circuit and presents its bond in the



Bond on appeal,  
filed Feb. 24,  
1903.

penal sum of three hundred dollars, which is approved and ordered filed and said appeal is allowed to have reviewed in said Circuit Court of Appeals the decree heretofore entered herein.

268 And on to-wit: the 24th day of February, 1903, came the

National Phonograph Company a corporation as principal and the National Surety Company as surety and filed in the clerk's office of said Court in said entitled cause a certain Bond in words and figures following to-wit:

269 Know All Men By These Presents That the National Phonograph Company, a corporation duly organized and existing under the laws of the State of New Jersey, as principal, and the National Surety Company, a corporation under the laws of the State of New York, licensed to do business within the State of Illinois, with offices at Number 558, The Rookery, Chicago, Illinois, as surety, are held and firmly bound unto the Lambert Company and Thomas B. Lambert in the penal sum of Three Hundred Dollars (\$300.00) lawful money of the United States, for which payment, well and truly to be made, we bind ourselves, our respective successors and assigns, jointly and severally, firmly by these presents.

Sealed with our seals and dated the 19th day of February, A. D. 1903.

Whereas, lately at a session of the United States Circuit Court for the Northern District of Illinois, Northern Division, in a suit pending in said Court between the said National Phonograph Company, complainant, and the Lambert Company and Thomas B. Lambert, defendants, a decree was entered on the 24th day of February, 1903, dismissing the Bill, and the said National Phonograph Company, the complainant in said suit, has obtained an order from said Circuit Court of the United States for the Northern District of Illinois, Northern Division, allowing an appeal to the United States Circuit Court of Appeals for the Seventh Circuit from said decree dismissing said bill, and a citation directed to the said Lambert Company and Thomas B. Lambert is about to be issued citing and admonishing them to be and appear at the United States Circuit Court of Appeals for the Seventh Circuit, to be held in the City of Chicago, County of Cook and State of Illinois, at the time stated therein;

Now Therefore, the condition of the above obligation is such that if the said National Phonograph Company shall prosecute its said appeal to effect and answer all damages and costs that may be awarded against it if it should fail to make good its said appeal,

then the above obligation to be void; otherwise to remain in full force and effect. Bond on appeal,  
filed Feb. 24,  
1903.

NATIONAL PHONOGRAPH COMPANY,  
By RICHD. N. DYER  
*Attorney.*

NATIONAL SURETY COMPANY,  
By A. J. ANDREWS  
*Resident Vice President*

HENRY L. AYERS  
*Resident Ass't Secretary*

The foregoing is satisfactory to me both as to form and surety.

THOMAS FRANCIS SHERIDAN  
*Solicitor for Defendant.*

Approved February 24th, 1903.

KOHLSAAT  
*Judge.*

(Endorsed) Filed Feb. 24, 1903, Marshall E. Sampsell, Clerk.

270 And on to-wit the 24th day of February, 1903, there was filed in the clerk's office of said court in said entitled causes a certain Opinion in words and figures following to-wit:

271 IN THE UNITED STATES CIRCUIT COURT:

Opinion, filed Feb.  
24, 1903.

Northern District of Illinois

Northern Division.

National Phonograph Co.	}	No. 25,279
<i>v.</i>		
Lambert Co. and Thos. B. Lambert	}	Consolidated
<i>v.</i>		
Edison Phonograph Co.		
<i>v.</i>		
Lambert Co. and Thos. B. Lambert		No. 25,788.

Kohlsaat, District Judge:

The bills in the above causes were brought to restrain infringement and for accounting. Inasmuch as they involve exactly the same subject matter, Counsel have stipulated that they be heard by



Opinion, filed Feb.  
24, 1903.

the Court, together. They now come before the Court on final hearing.

The suit of Edison Co. v. Lambert Co. etc., is based upon patent No. 382,418 which consists of three claims, reading as follows: 1st., A phonogram blank or phonogram having a bore tapered throughout its length, substantially as set forth.

2nd., A phonogram blank or phonogram having a cylindrical recording surface and a tapering bore, substantially as shown.

3rd., Same as 2nd. with the addition of the words, after the word surface, "of wax or wax-like material". (As to this claim, complainant seeks no relief.)

And the three claims of patent No. 382,462, reading as follows:

1st., "A phonogram blank or phonogram constructed wholly of wax or wax-like materials, and having the same coefficient of expansion throughout its mass, substantially as set forth.

2nd., "A phonogram blank or phonogram constructed as a hollow cylinder wholly of wax or wax-like materials and having the same coefficient of expansion throughout its mass, substantially as set forth.

3rd., "A phonogram blank or phonogram constructed as a hollow cylinder, with a tapering bore wholly of wax or waxlike materials and having the same coefficient of expansion throughout its mass, substantially as set forth."

272 The other suit, National Phonograph Co. v. Lambert Co. etc., is based upon the first and third claims of patent No. 414,761, reading as follows:

1st., "A tubular phonogram blank provided with internal ribs or projections, substantially as set forth.

3rd., "A tubular phonogram blank made of molded material and molded with ribs or projections on its inner surface, substantially as set forth."

There is no doubt in my mind that complainant's patents are valid and that they are entitled to the relief prayed, provided defendants are infringers. The advance made by science into the phonographic domain, may be said to be like an excursion into the metaphysics of nature. Every forward move, no matter how insignificant, paves the way for another step. Nor does the discovery of the natural laws involved in the phonograph require any more abstruse and intricate conceptions than those which reduce the discovery to practical use.

The complainants have made considerable improvements, both novel and useful, which are entitled to a generous construction. The first question presented is whether defendants' record or phono-



Opinion, filed Feb.  
24, 1903.

gram is an infringement of claims 1 and 2 of complainant's patent #382,418, for a phonogram having a bore tapered throughout its length", or in other words is defendants' phonogram or record, with its end flanges varying in depth to engage a tapered mandrel at each end of the record, an equivalent of complainant's tapered bore? In the prior art various methods were devised for holding the record securely and firmly upon the mandrel. It was found that so doing by means of endwise clamping or pressure, was not convenient or satisfactory. Later the method of holding the record in place by means of a tapering mandrel or core at one end was adopted in the manufacture of records. By this means the record was held frictionally at its forward end, while the body and the outward end were, when subjected to pressure, unsteady and lacking in firmness.

Exactness is essential to the operation of these records successfully. Complainant's said devise remedied this defect. It is simple and adequate.

In view of the delicacy of the phonogram art, I am satisfied it contains novelty and invention. Defendants' devise, is of material rigid and strong enough to effect this result with no other than end frictional engagements with the mandrel. Defendants claim that their record may be used upon a stepped mandrel just as well. In my judgment, this would not alter the character of the device. Complainant was the first to establish frictional engagement of the record with the mandrel at both ends as well as throughout its length. I am further of the opinion from the record, that the defendants' device with its end flanges varying in depth to engage a tapering mandrel is an infringement of claims one and two of complainant's said patent No. 382,418 and that, as to such infringement, complainant is entitled to the injunction prayed.

Considering now the claims of said patent No. 382,462, I am of the opinion that so far as the same involve the frictional contact with a tapering mandrel by means of a tapering bore, as above referred to complainant is entitled to the injunctive order as prayed for in its bill.

As set out in these last named claims, complainant's devices are constructed of wax or wax like material sometimes denominated a metallic Soap, Defendants' device is made of celluloid. Complainant's record is cut or engraved by a sharp pointed instrument or stylus. Defendants' record is not engraved at all, but is embossed. The celluloid, in a softened condition is mechanically forced upon a prepared matrix and then hardened. The embossed phonogram is the result. Celluloid was experimented with by complainants or those under whom it claims, as a substance for the manufacture of



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24, 1903.

its records. It was found to be satisfactory as an engravable surface and was abandoned. Under defendants' process of manufacture, no phonogram blank is made, unless it can be said that the blank and the record are produced at the same time by the same means. It is true that the substance used by complainant as 274 well as celluloid, is amorphous, or without chrystalization. So is glass. I am unable to discern the resemblance between the two. Celluloid is essentially the product of gun cotton and camphor. I find no warrant for the claim that it is in any sense, wax or wax-like. It is not brittle like wax. It is very hard and cannot be shaved, as is claimed for complainant's records. It does not crack when spread upon any other substance not of the same expanding or contracting properties, and its cylinder is practically indestructible. In my judgment defendants do not infringe in the matter of material used in constructing their phonogram, and the prayer of the bill for an injunction in that respect is denied.

There remains the bill numbered 25,788 relating to Patent No. 414,761, for a tubular phonogram having ribs or projections on its inner surface. It is claimed by complainant that the flanges at the ends of defendants' phonograms are the equivalents of the ribs of this patent. I do not think so. I am of the opinion that the injunction heretofore directed to issue as to claims one and two of patent No. 382,418, fully covers all the just cause of complaint, complainant may have against defendant in this cause. The prayer for injunction in this cause is denied. Counsel may draw up the decree in accordance herewith.

275 And on to-wit: the 24th day of February, 1903, being one of the days of the regular December term of said Court, 1902, in the record of proceedings thereof in said entitled cause before the Hon. Christian C. Kohlsaas, District Judge, appears the following entry to-wit:



Decree, Feb. 24,  
1903.

Ordered, Adjudged and Decreed as follows:

II. That the complainant recover of the defendants, Lambert Company and Thomas B. Lambert, and each of them, the profits, gains and advantages which they, the said defendants, have received or made or which have arisen or accrued to them by reason of their infringement of the said Letters Patent No. 382,418, together with the damages which the complainant has sustained by reason of such infringement.

III. That this cause be referred to one of the Masters of this Court, to ascertain and take and report to the Court an account of the said profits and also the amount of damages sustained by the said complainant from such infringement; that the complainant on such accounting have the right to cause an examination of the defendant Lambert Company, and its officers, servants, agents, attorneys, employees, workmen and confederates, and of the defendant, Thomas B. Lambert, and his servants, agents, attorneys, employes, workmen and confederates, *ore tenus* or otherwise, and also to cause the production of the books,



Decree, Feb. 24,  
1903.

vouchers and documents of each of the said defendants, and that the said defendant Lambert Company and its officers, servants, agents, attorneys, employees, workmen and confederates, and the said defendant Thomas B. Lambert, and his servants, agents, 278 attorneys, employees, workmen and confederates, attend for the purpose of such accounting before said Master from time to time as he shall direct.

IV. That a perpetual injunction be issued herein against the defendant Lambert Company and its officers, servants, agents, attorneys, employees, workmen and confederates, and the defendant Thomas B. Lambert and his servants, agents, attorneys, employees, workmen and confederates, and each and every of them, enjoining and restraining them, and each and every of them, from directly or indirectly making, constructing, using, vending, delivering, working or putting into operation or use, or in anywise counterfeiting or imitating the said invention in claims 1 and 2 of said Letters Patent No. 382,418 set forth, or any phonogram blanks or phonograms made or operated in accordance therewith or like or similar to those which the said defendants have heretofore made, sold, constructed, operated or used, in infringement of said claims, and from in any way further infringing upon the said claims of said Letters Patent No. 382,418 or upon the rights of the complainant under the same.

And it is further Ordered, Adjudged and Decreed as follows:

1. That United States Letters Patent No. 382,462, granted May 8, 1888, to Thomas A. Edison for a new and useful improvement in Phonogram Blanks and Phonograms (being the other of the Letters Patent in suit) are good and valid Letters Patent; that the said Thomas A. Edison was the original and first inventor of the said invention described in said Letters Patent; that the title thereto and to the invention described and claimed therein is vested in 279 the complainant, but that the defendants herein do not infringe said Letters Patent.

II. That as to the said Letters Patent No. 382,462 the bill be and the same hereby is dismissed.

III. That neither of the parties hereto are awarded costs as against the other.

280 And on to-wit: the 24th day of February, 1903, being one of the days of the regular December term of said Court, 1902, in the record of proceedings thereof in said entitled cause before the Hon. Christian C. Kohlsaat, District Judge, appears the following entry to-wit:

281 Edison Phonograph Company,  
Complainant,  
vs.  
Lambert Company and Thomas B. Lambert,  
Defendants. } In Equity.  
No. 25,788.

Order of Feb. 24,  
1903, suspend-  
ing injunction.

On motion of solicitor for defendants, it is

Ordered, Adjudged and Decreed that the perpetual injunction granted in this cause be and the same is hereby suspended pending the hearing and determination of the appeal of the defendants Lambert Company and Thomas B. Lambert to the Circuit Court of Appeals for the Seventh Circuit from the interlocutory order granting said perpetual injunction, upon condition as follows:

That the said Lambert Company and Thomas B. Lambert promptly take, perfect and prosecute an appeal to the United States Circuit Court of Appeals for the Seventh Circuit.

282 And on to-wit: the 24th day of February, 1903, came Lambert Company and Thomas B. Lambert by their solicitor and filed in the clerk's office of said Court in said entitled cause a Petition for Appeal in words and figures following to-wit:

283 UNITED STATES CIRCUIT COURT,  
Northern District of Illinois,  
Northern Division.

Petition for appeal, filed Feb. 24, 1903.

National Phonograph Company,  
Complainant,  
vs.  
Lambert Company and Thomas B. Lambert,  
Defendants.

} In Equity.  
No. 25,788.

To the Honorable, the Judges of the Circuit Court of the United States for the Northern District of Illinois, Northern Division:

The above named defendants, Lambert Company and Thomas B. Lambert, conceiving themselves aggrieved by the final decree made and entered on the 24th day of February, 1903, in the above entitled cause, do hereby appeal from said decree to the United States Circuit Court of Appeals for the Seventh Judicial Circuit for the reasons specified in the assignment of errors which is filed here-



Petition for appeal, filed Feb. 24, 1903.

with, and prays that this appeal may be allowed and a citation granted directed unto the above named complainant, commanding it to appear before the United States Circuit Court of Appeals for the Seventh Judicial Circuit to do and receive what may appertain to justice to be done in the premises, and that a transcript of the record, proceedings and papers upon which said decree was made may be duly authenticated and sent to the United States Circuit Court of Appeals for the Seventh Judicial Circuit.

Chicago, Illinois, February 24th, 1903.

LAMBERT COMPANY AND THOMAS B. LAMBERT,  
By THOMAS FRANCIS SHERIDAN  
*Solicitor.*

The foregoing petition of appeal is allowed.  
Chicago, Illinois, February 24th, 1903.

(Endorsed) Filed February 24, 1903, Marshall E. Sampsell,  
Clerk.

284 And on to-wit: the 24th day of February, 1903, came Lambert Company and Thomas B. Lambert by their solicitor and filed in the clerk's office of said court in said entitled cause their certain assignment of errors in words and figures following to-wit:

Assignment of errors, filed Feb. 24, 1903.

285

### ASSIGNMENT OF ERRORS.

CIRCUIT COURT OF THE UNITED STATES.

Northern District of Illinois.

Northern Division.

Edison Phonograph Company,	} In Equity. No. 25,788.
<i>Complainant,</i>	
<i>vs.</i>	
Lambert Company and Thomas B. Lambert,	} Defendants.
<i>Defendants.</i>	

And now come the Lambert Company and Thomas B. Lambert, the defendants in the above entitled cause, and say that the interlocutory decree ordering a perpetual injunction in this cause is erroneous and against the just rights of these defendants, and that the Circuit Court of the United States for the Northern District of

Illinois erred in granting this decree ordering a perpetual injunction in this cause, for reasons as follows:

1. The Circuit Court of the United States for the Northern District of Illinois erred in refusing to deny the motion of complainant for a perpetual injunction.

2. The Circuit Court of the United States for the Northern District of Illinois erred in ordering a perpetual injunction to issue against each of the defendants, their officers, servants, agents, attorneys, employees, workmen and confederates, and each and every of them, enjoining and restraining them from directly or indirectly making, constructing, using, vending, delivering, working or putting into operation or use, or in anywise counterfeiting or imitating the said inventions of claims 1 and 2 of Letters Patent of the United States No. 382,418, granted to Thomas A. Edison May 8, 1888, for Improvements in Phonogram Blanks.

3. The Circuit Court of the United States for the Northern District of Illinois erred in finding that the phonograph records of the defendant Lambert Company were made, sold and used by it in infringement of claims 1 and 2 of said Letters Patent of the United States No. 382,418, granted to Thomas A. Edison May 8, 1888.

4. The Circuit Court of the United States for the Northern District of Illinois erred in ordering a perpetual injunction to be issued enjoining and restraining the defendants, their agents, attorneys, servants, employees, workmen and confederates, and each and every of them, from making, using, or selling, or in any way disposing of of phonograph records similar to or like the phonograph records heretofore manufactured or sold by the said defendant Lambert Company.

5. The Circuit Court of the United States for the Northern District of Illinois erred in not finding that complainant is not entitled to have claim 1 of Letters Patent of the United States No. 382,418, granted to Thomas A. Edison May 8, 1888, construed broad enough to include a phonogram record having a stepped bore, such as the phonogram records manufactured by the defendant Lambert Company, in view of the fact that the claim is limited by precise wording to "a phonogram blank or phonogram having a bore tapered throughout its length."

6. The Circuit Court of the United States for the Northern District of Illinois erred in not finding that the complainant is not entitled to have claim 2 of Letters Patent of the United States No. 382,418, granted to Thomas A. Edison May 8,



Assignment of  
errors, filed  
Feb. 24, 1903.

1888, construed broad enough to include a celluloid phonograph record which does not have a cylindrical recording surface and which is provided with a stepped bore, in view of the fact that the claim is limited in precise terms to "a phonogram blank or phonogram having a cylindrical recording surface and a tapering bore."

7. The Circuit Court of the United States for the Northern District of Illinois erred in not finding that claims 1 and 2 of Letters Patent of the United States No. 382,418, granted to Thomas A. Edison May 8, 1888, for Improvements in Phonogram Blanks or phonograms are invalid in view of the prior art submitted to the Court by the defendants in this cause.

8. The Circuit Court of the United States for the Northern District of Illinois erred in refusing to deny the motion of complainant for a perpetual injunction in this cause, because, in view of the record presented, the question of infringement by the defendants or either of them is not clear and free from doubt.

Wherefore, the Lambert Company and Thomas B. Lambert, the defendants in this cause, pray that the interlocutory decree of the Circuit Court of the United States for the Northern District of Illinois granting a perpetual injunction against the defendants, their servants, agents, attorneys, employees, workmen and confederates, and each and every of them, in this cause be reversed, and that the Circuit Court of the United States for the Northern District of Illinois be ordered to enter an order denying the motion of complainant for a perpetual injunction and accounting against the defendants in this cause.

THOMAS FRANCIS SHERIDAN  
*Solicitor for Defendants.*

Chicago, February 24th, 1903.

(Endorsed) Field Feb., 24, 1903, Marshall E. Sampsell, Clerk.

289 And on to-wit: the 24th day of February, 1903, being one of the days of the regular December term of said Court, 1902, in the record of proceedings thereof in said entitled cause before the Hon. Christian C. Kohlsaat, District Judge, appears the following entry to-wit:

290

## CIRCUIT COURT OF THE UNITED STATES,

Northern District of Illinois,

Northern Division.

Edison Phonograph Company,

*Complainant,**vs.*

Lambert Company and Thomas B. Lambert,

*Defendants.*} In Equity.  
No. 25,788.Order of Feb. 24,  
1903, allowing  
appeal.

And now come the defendants by their solicitor, Thomas F. Sheridan, and pray an appeal to the United States Circuit Court of Appeals for the Seventh Circuit and present their bond in the penal sum of Three Hundred Dollars, which is approved and ordered filed and said Appeal allowed to have reviewed in said Circuit Court of Appeals the decree heretofore entered herein.

291 And on to-wit: the 24th day of February, 1903, came Lambert Company, as principal and Pacific Surety Company, of California as surety and filed in the clerk's office of said Court in said entitled cause a certain Bond on Appeal in words and figures following to-wit:

Bond on appeal,  
filed Feb. 24,  
1903.

292 Know All Men By These Presents, That we, the Lambert Company, duly organized and incorporated under the laws of the State of Illinois, as principal, and the Pacific Surety Company, of California, licensed to do business within the State of Illinois, and with offices at 139 Hartford Building, Chicago, Illinois, as surety, are held and firmly bound unto the Edison Phonograph Company, of New Jersey, in the penal sum of Three Hundred Dollars, lawful money of the United States, to which payment well and truly to be made we bind ourselves, our respective successors and assigns, jointly and severally, firmly by these presents.

Sealed with our seals and dated the 18th day of February A. D. 1903.

Whereas, lately at a session of the United States Circuit Court for the Northern District of Illinois, Northern Division, in a suit pending in said Court between the Edison Phonograph Company, complainant, and the said Lambert Company and Thomas B. Lambert, defendants, an interlocutory decree was entered on the .....



Bond on appeal,  
filed Feb. 24,  
1903.

day of February, 1903, granting a perpetual injunction against the defendants therein; and the said Lambert Company, and Thomas B. Lambert, the defendants in said suit, have obtained an order from said Circuit Court of the United States for the Northern District of Illinois allowing an appeal to the United States Circuit Court of Appeals for the Seventh Circuit from the said interlocutory decree granting a perpetual injunction against the said defendants therein, and a citation directed to the said Edison Phonograph Company is about to be issued citing and admonishing it to be and appear at the United States Circuit Court of Appeals for the Seventh Circuit, to be held in the City of Chicago, County of Cook and State of Illinois, at the time stated therein.

Now, Therefore, the condition of the above obligation is such that if the said Lambert Company and Thomas B. Lambert shall prosecute its said appeal to effect and answer all damages and costs that may be awarded against them if they should fail to make good their said appeal, then the above obligation to be void, otherwise to remain in full force and effect.

LAMBERT COMPANY,  
By BRIAN F. PHILPOT,  
*President.*

PACIFIC SURETY COMPANY,  
By STUART G. SHEPARD,  
*Resident Assistant Secretary.*  
ALLAN C. DURBORROW,  
*General Agent.*

[CORPORATE SEAL.]

The foregoing is satisfactory to us, both as to form and surety.  
ISHAM, LINCOLN & BEALE,  
*Solicitors for Complainant.*

Approved February 24th, 1903.

KOHLSAAT, J.

(Endorsed) Filed Feb. 24, 1903, Marshall E. Sampsell, Clerk.

293 And on to-wit, the 24th day of February, 1903, there was filed in the clerk's office of said court in said entitled cause a certain stipulation in words and figures following to-wit:

294

STIPULATION.

Stipulation, filed  
Feb. 24, 1903.

CIRCUIT COURT OF THE UNITED STATES,

Northern District of Illinois,

Northern Division.

Edison Phonograph Company,  
*Complainant,*

*vs.*

Lambert Company and Thomas B. Lambert,  
*Defendants.*

} In Equity.  
No. 25,788.

It is hereby stipulated and agreed by and between counsel for the respective parties hereto that the extracts from the depositions of Thomas A. Edison, taken from the case of American Graphophone Company vs. Loring L. Leeds et al., and stipulated into this cause but which were not printed in the record, may be left out of the transcript of record in the Court of Appeals.

ISHAM. LINCOLN & BEALE

*Solicitors for Complainant.*

THOMAS F. SHERIDAN

*Solicitor for Defendants.*

Chicago, February 24th, 1903.

(Endorsed) Filed Feb., 24, 1903, Marshall E. Sampsell, Clerk.

295 And on to-wit the 24th day of February, 1903, there was filed in the clerk's office of said court in said entitled cause a certain stipulation in words and figures following towit:



Stipulation, filed  
Feb. 24, 1903.

CIRCUIT COURT OF THE UNITED STATES,

Northern District of Illinois,

Northern Division.

National Phonograph Company,	}	25789
<i>vs.</i>		
Lambert Company and Thomas B. Lambert,		
Edison Phonograph Company,	}	25788
<i>vs.</i>		
Lambert Company and Thomas B. Lambert.		

It is hereby stipulated and agreed that the clerk in preparing the transcript of record herein may use a copy of the printed records, omitting the several headings to the different parts of such records, and we hereby waive all errors that may appear in such printed records without prejudice to the rights of either party to have any corrections made that may appear to be material or necessary.

ISHAM LINCOLN & BEALE

*Solicitors for Complainant.*

THOMAS F SHERIDAN

*Solicitors for Defendants*

ISHAM LINCOLN & BEALE

*Solicitors for Complainant.*

THOMAS F SHERIDAN

*Solicitors for Defendants.*

(Endorsed) Filed Feb., 24, 1903, Marshall E. Sampsell, Clerk.

**Defendants' Exhibit A.**

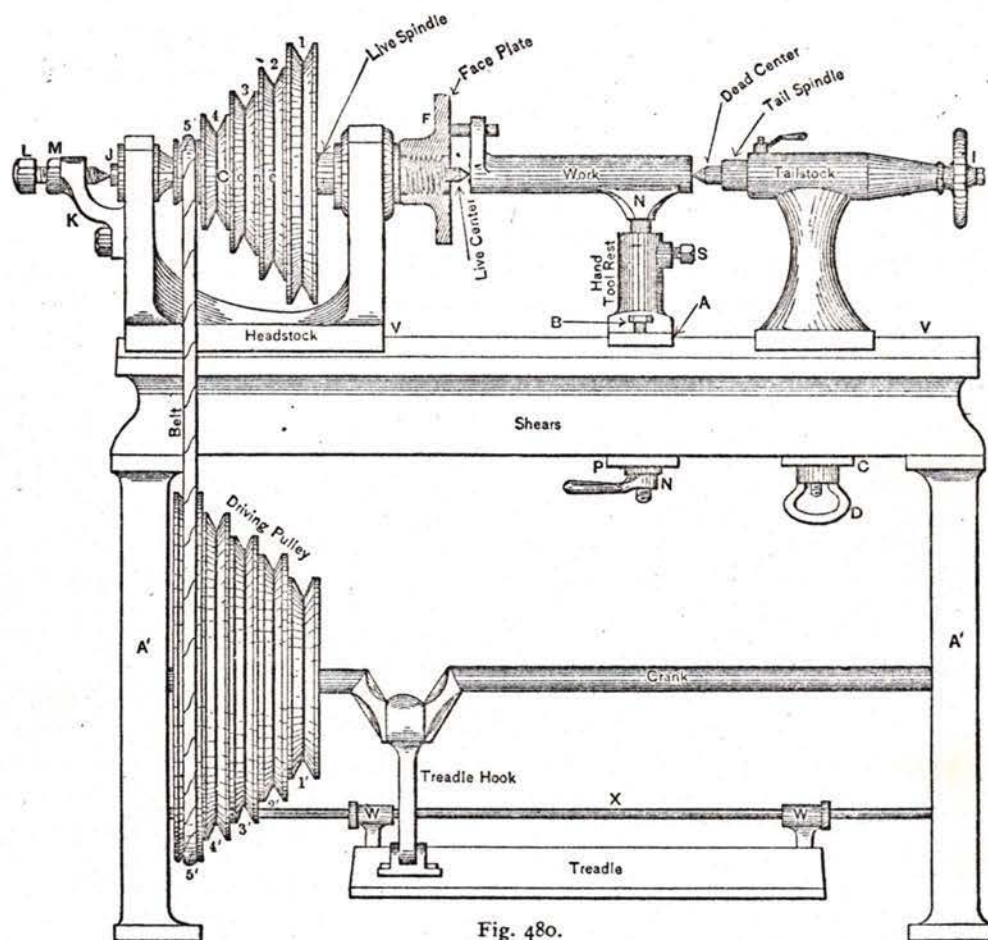


Fig. 480.





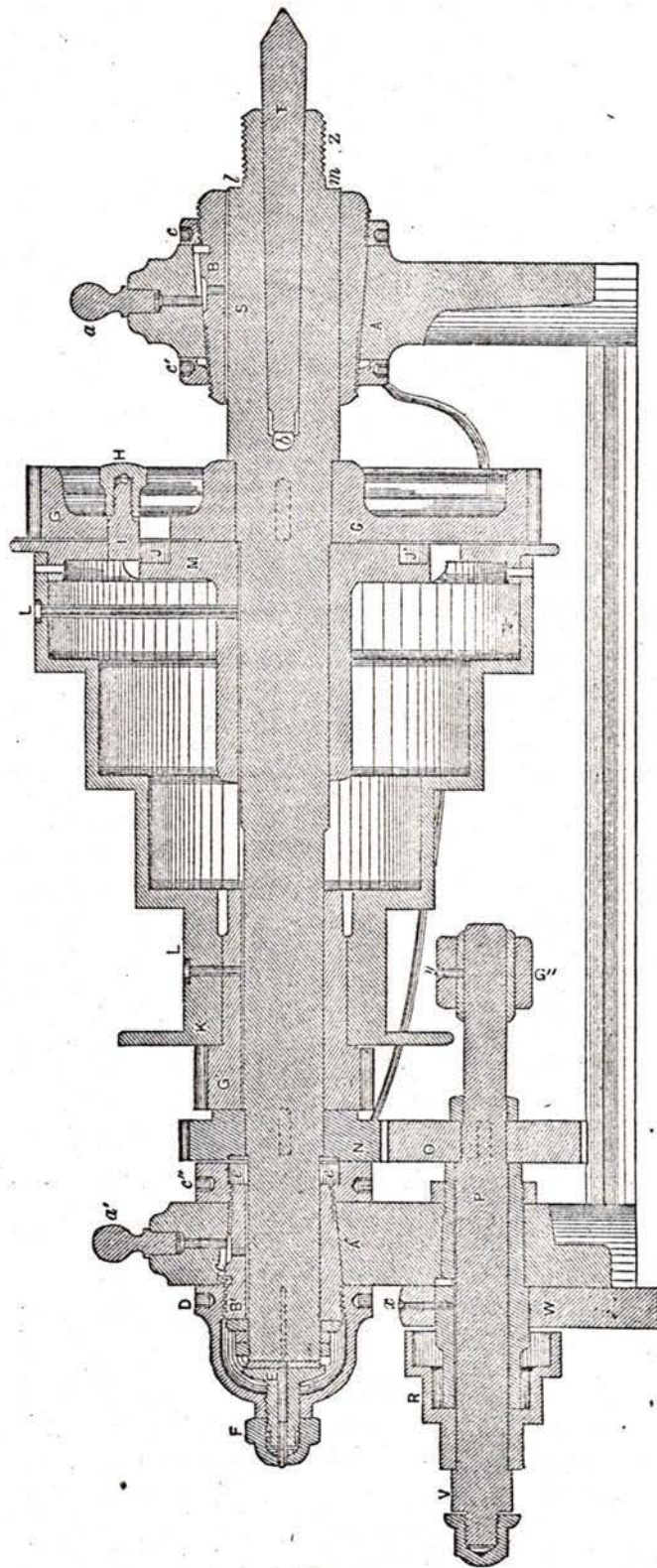
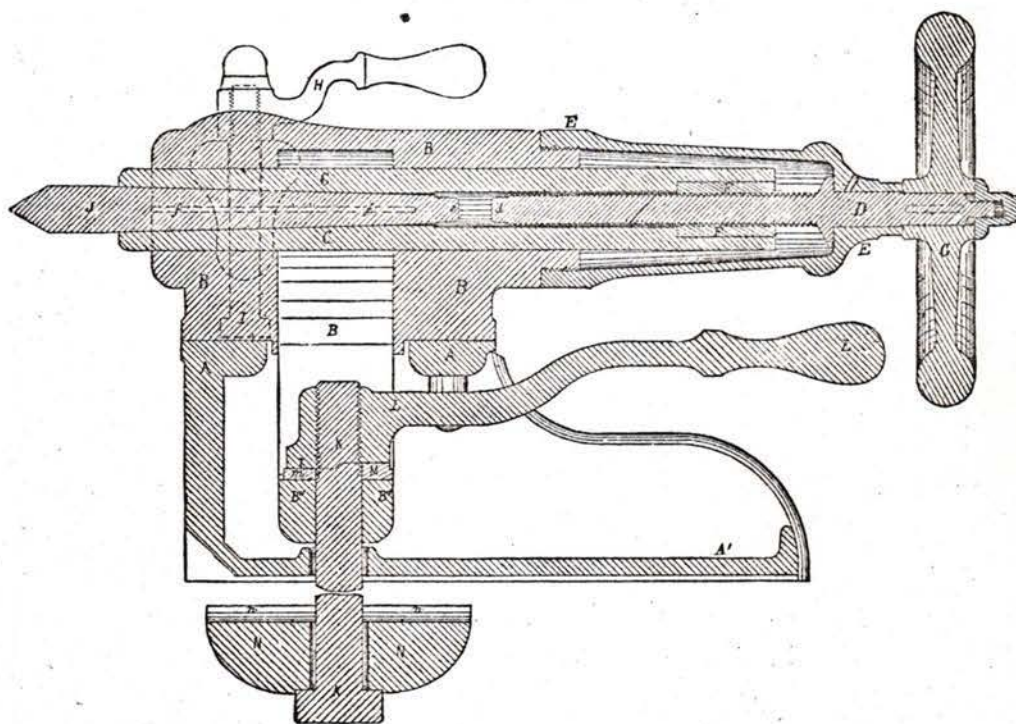


Fig. 494.

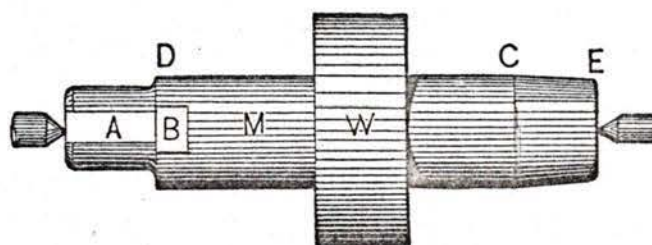




**Defendants' Exhibit C.**

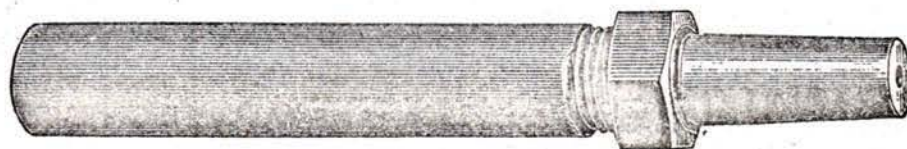




**Defendants' Exhibit D.****Fig. 777.**

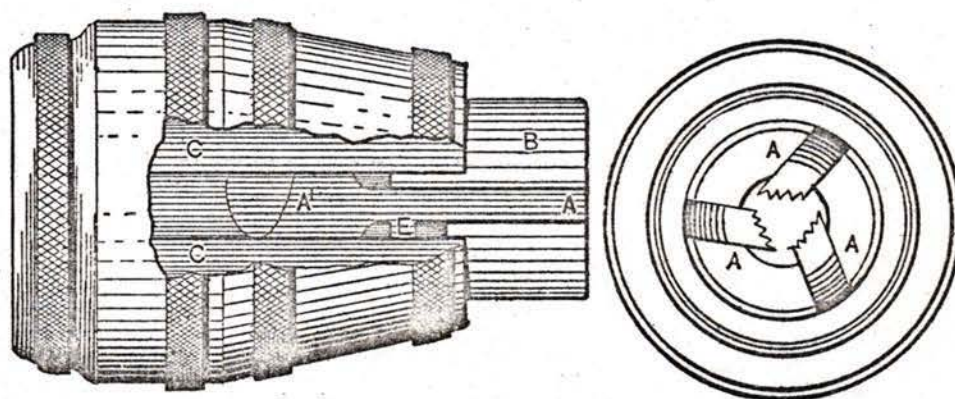




**Defendants' Exhibit E.****Fig. 795.**

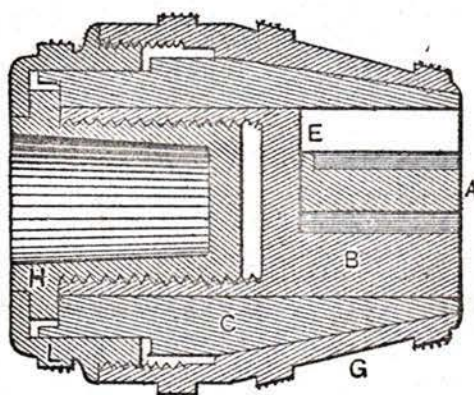




**Defendants' Exhibit F.****Fig. 819.**





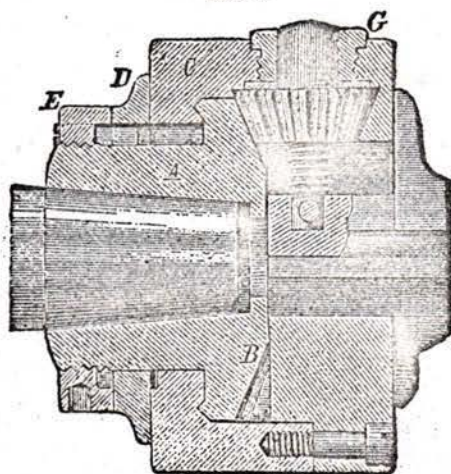
**Defendants' Exhibit G.****Fig. 820.**



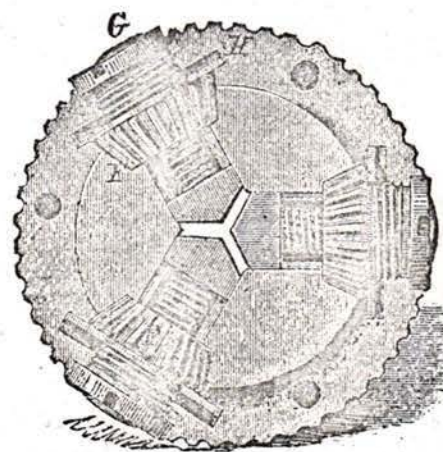


## Defendants' Exhibit H.

2624.



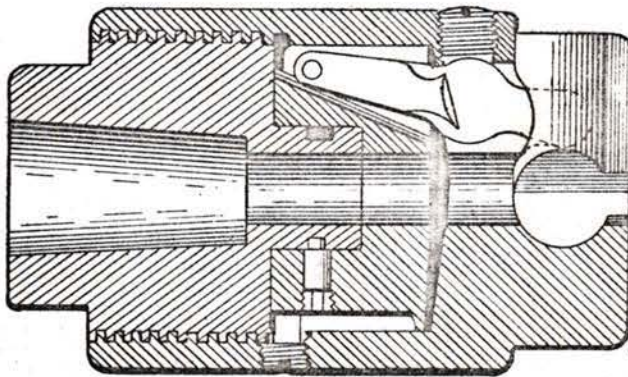
2625.







*Defendants Exhibit "J."*

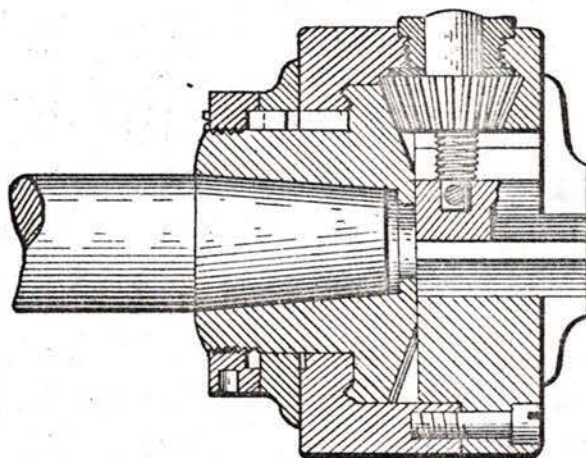


*Scientific American*  
*Volume 35, Page 210.*





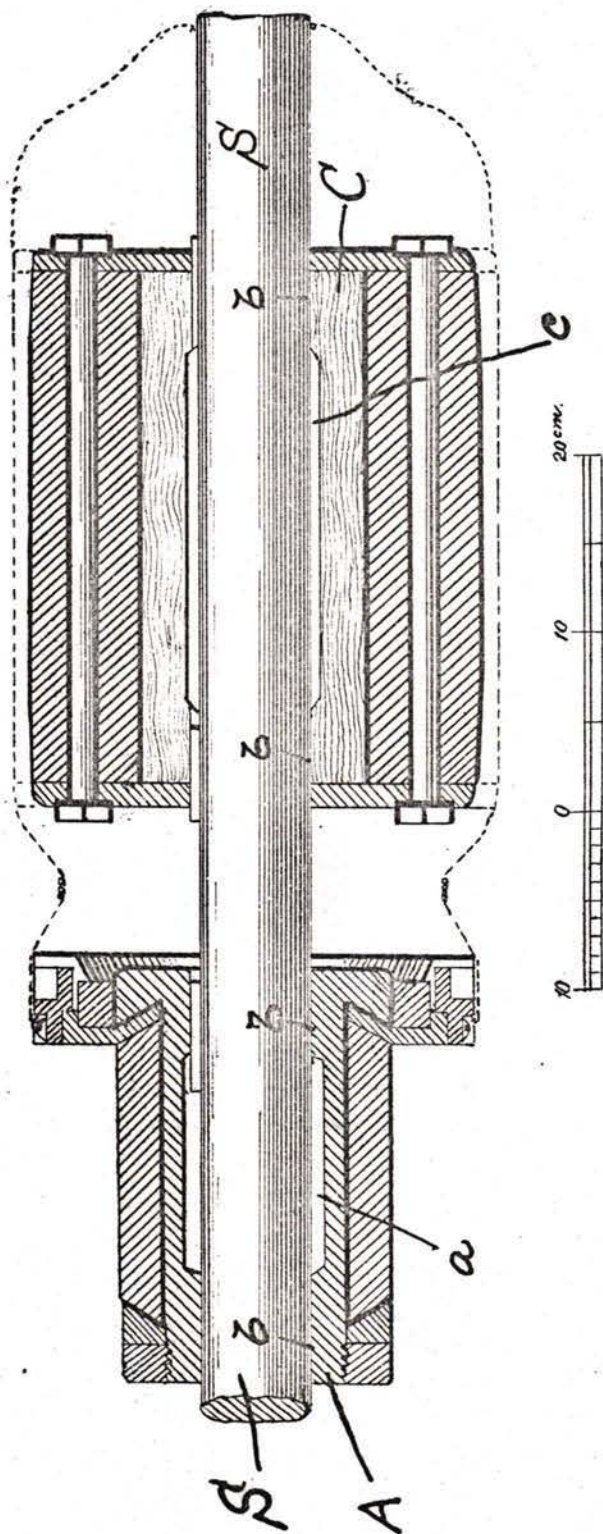
*Defendants Exhibit "K."*



*Scientific American*  
*Volume 36, Page 118.*







"Defendants Exhibit I"  
 Tracing of Fig. 430, page 607,

*HANDBUCH*  
 DER  
*ELEKTROTECHNIK.*

BY  
DR. ERASMUS KITTLER.









272

(No Model.)

T. A. EDISON.  
PHONOGRAM BLANK.

No. 414,761.

Patented Nov. 12, 1889.

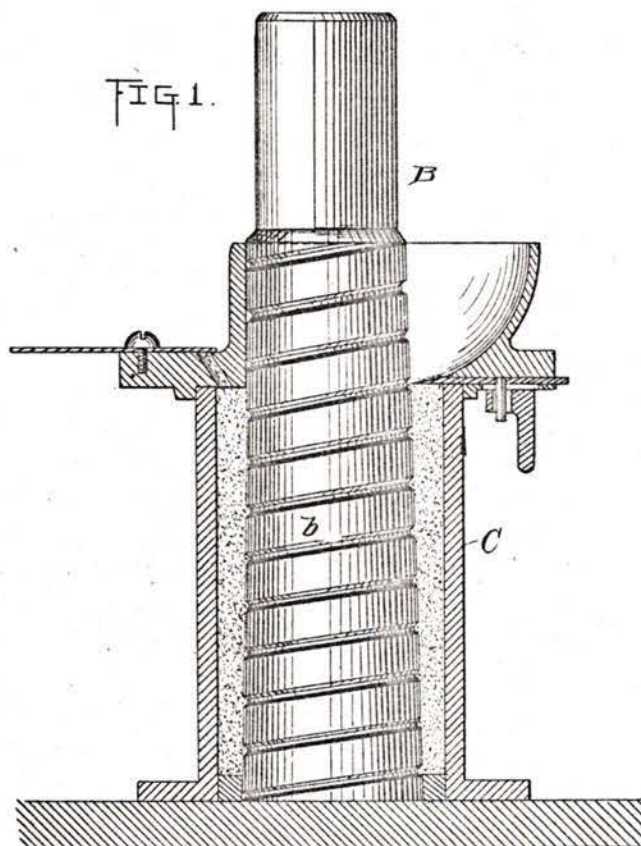
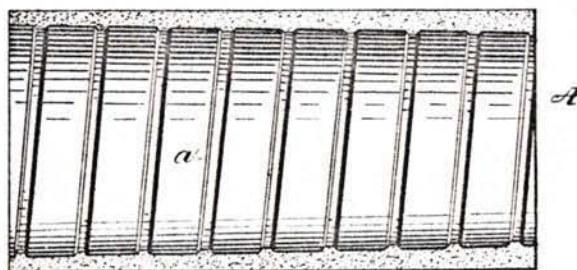


FIG 2.



Witnesses  
*Ed. Rowland*  
*William P. Fizer*

Inventor  
*Thomas A. Edison*  
By *his* Attorneys *Geo. F. Sney*

# UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

## PHONOGRAM-BLANK.

SPECIFICATION forming part of Letters Patent No. 414,761, dated November 12, 1889.

Application filed August 10, 1889. Serial No. 320,398. (No model.)

### *To all whom it may concern:*

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Phonogram-Blanks, (Case No. 840,) of which the following is a specification.

My invention relates to cylindrical blanks for receiving sound-records in the phonograph, made of wax or wax-like or similar materials, and designed to be placed on the cylinder of the phonograph for receiving and reproducing the sound-record. Heretofore these cylinders have been made with a smooth inner surface fitting closely upon the cylinder of the phonograph. I have found that several advantages arise from providing the interior of the cylindrical phonogram-blank with ribs, flanges, or projections, and it is in this that my invention mainly consists. This construction makes it easier to remove the molded blank from the mold in which it is formed, enables the injurious effects of contraction or warping of the cylinder to be readily removed, and prevents any bad effect from the accumulation of dust on the cylinder of the phonograph. I prefer to form a spiral rib on the interior surface of the blank.

My invention is illustrated in the accompanying drawings.

Figure 1 is a view illustrating the process of molding the blank, the mold being shown in section; and Fig. 2 is a longitudinal section of the complete phonogram-blank embodying my invention.

Referring to Fig. 2, A is the cylindrical blank, having a tapering bore and a true cylindrical outer surface, and made of a suitable molded material capable of receiving impressions of the recording-point in the phonograph. On the interior of the cylinder is formed a spiral rib *a*. In making such a cylinder I prefer to employ a cylindrical tapering core B, on the surface of which is formed a spiral groove *b*, and which is placed in the mold C, of the kind described in my prior applications and patents, and the material for forming the blank is poured into the mold around the core, so that as it hardens it forms a cylindrical body having a tapering

bore and formed with a spiral rib on its inner surface. I find it easier to remove such a blank from the core than one having a smooth inner surface, since by slightly turning or screwing the same it can be readily withdrawn.

In the process of molding the blank while the material cools it sometimes becomes contracted or warped on its inner surface, so that it does not fit the phonogram-cylinder truly, and in this case it has to be reamed out to remove the irregularities. This has to be allowed for in making the blanks, and when the blank is made with a smooth interior the whole inner surface often has to be cut in order to make it true, and this is a matter of some difficulty and incurs a risk of injury to the blank. Where the blank is formed with an internal rib or ribs and such warping occurs, it is only necessary in order to remove it to cut away the edges of the ribs, and thus a blank having a true inner surface can be formed with less labor and expense and waste of material than where the smooth surface is used. I make the ribs always deep enough to allow for the reaming out of the cylinder. Another advantage is that when the blank is placed on the phonogram-cylinder any particles of dust or other foreign substance which may be on the cylinder enter and remain in the spaces between the ribs, instead of coming between the blank and the cylinder, where they might prevent the blank from assuming a true position and resting evenly thereon.

What I claim is—

1. A tubular phonogram-blank provided with internal ribs or projections, substantially as set forth.

2. A tubular phonogram-blank having an internal spiral rib, substantially as set forth.

3. A tubular phonogram-blank made of molded material and molded with ribs or projections on its inner surface, substantially as set forth.

This specification signed and witnessed this 16th day of July, 1889.

THOS. A. EDISON.

Witnesses:

D. H. DRISCOLL,  
WILLIAM PELZER.









276

(No Model.)

T. A. EDISON.  
PHONOGRAM BLANK.

No. 382,418.

Patented May 8, 1888.

FIG. 1.

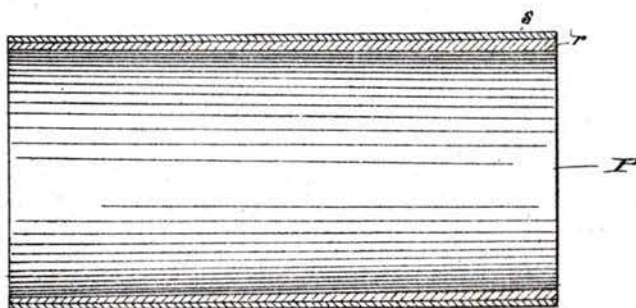
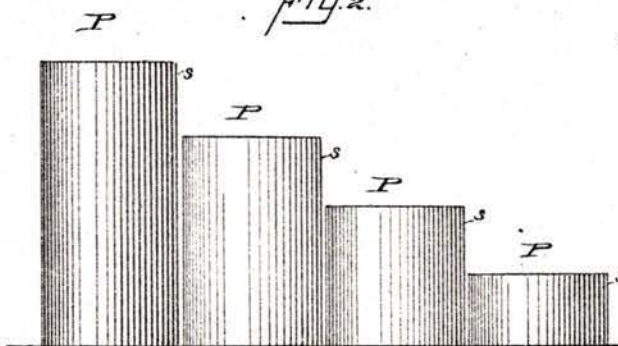


FIG. 2.



Witnesses,  
*E. J. Howard*  
*William C. Clegg*

Inventor,  
*Thomas A. Edison*  
By his Attorneys  
*Dyer & Seely*

# UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

## PHONOGRAM-BLANK.

SPECIFICATION forming part of Letters Patent No. 382,418, dated May 8, 1888.

Original application filed November 26, 1887 Serial No. 256,189. Divided and this application filed March 2, 1888. Serial No. 265,889. (No model.)

### *To all whom it may concern:*

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Phonogram-Blanks and Phonograms, (Case No. 762, division of Case No. 741,) of which the following is a specification.

The object I have in view is to produce a cylindrical phonogram blank or phonogram which can be readily placed upon the phonogram-cylinder of a phonograph, and will center itself, and will also be adapted to retain its place upon the phonogram-cylinder by friction alone. This I accomplish by providing the cylindrical phonogram blank or phonogram with a tapering bore adapted to fit over a similarly-tapered phonogram-cylinder. The phonogram-blank or phonogram is provided with a cylindrical recording-surface. Blanks or phonograms of the full length of the tapering phonogram-cylinder of the phonograph can be used as well as those of shorter length, the tapering bore centering the blank or phonogram, and adapting it to be pushed onto the phonogram-cylinder until it binds thereon with sufficient friction to hold it in place.

In the accompanying drawings, forming a part hereof, Figure 1 is a sectional view of a phonogram-blank or phonogram, showing by dotted lines its division into sections; and Fig. 2 an elevation, showing four different sizes of the phonogram-blank or phonogram.

P represents phonogram-blanks or phonograms. They have a cylindrical recording-surface, *s*, made of wax, or a wax-like substance, which may be mounted upon a backing, *r*, which is also a cylinder, but has a tapering bore adapted to fit upon a similarly-tapered phonogram-cylinder of a phonograph.

I propose to make these phonogram-blanks the entire length of the phonogram-cylinder, and also to divide such full-length phonogram-blanks into parts, so that sectional phonogram-blanks will be produced, which will be, for illustration, one-fourth, one half, and three-fourths the length of the full-size phonogram blanks. All of these sectional phonogram blanks, as well as the full-sized phonogram-blank, will have the tapering bore, so that they can be pushed upon the tapering phonogram-cylinder until they bind, and the instrument can then be adjusted to them for recording and reproducing.

I do not claim herein a phonogram-blank having a recording surface of wax, or a wax-like material, nor such a surface mounted upon backing of tougher material, such matters being covered by my application for patent, (Case No. 734, Serial No. 252,964,) filed October 21, 1887.

### What I claim is—

1. A phonogram-blank or phonogram having a bore tapered throughout its length, substantially as set forth.
2. A phonogram blank or phonogram having a cylindrical recording-surface and a tapering bore, substantially as set forth.
3. A phonogram-blank or phonogram having a cylindrical recording-surface of wax or wax-like material and provided with a tapering bore, substantially as set forth.

This specification signed and witnessed this 20th day of February, 1888.

THOS. A. EDISON.

### Witnesses:

WILLIAM PELZER,  
E. C. ROWLAND,









280 (No Model.)

T. A. EDISON.  
PHONOGRAM BLANK.

No. 382,462.

Patented May 8, 1888.

Fig. 1

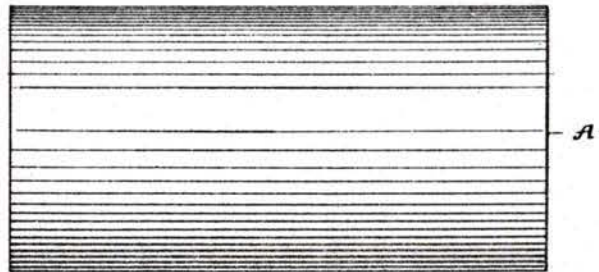


Fig. 2

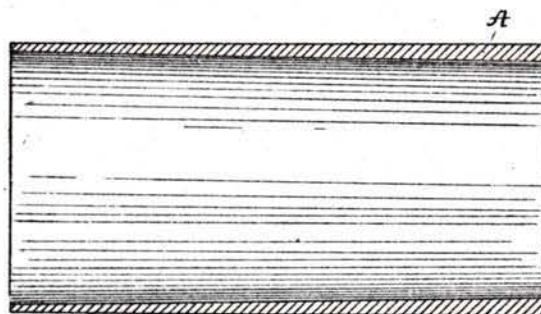
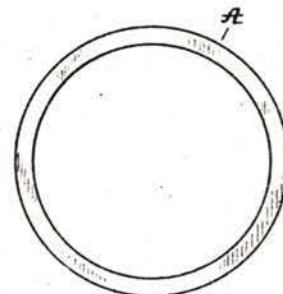


Fig. 3



Witnesses.  
*E. Rowland*  
*William P. Jr.*

Inventor.  
*Thomas A. Edison*  
By his Attorneys *Jay & Seely*

# UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

## PHONOGRAM-BLANK.

SPECIFICATION forming part of Letters Patent No. 382,462, dated May 8, 1888.

Application filed January 5, 1888. Serial No. 259,898. (No model.)

*To all whom it may concern:*

Be it known that I, THOMAS A. EDISON, of Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Phonogram-Blanks and Phonograms, (Case No. 747,) of which the following is a specification.

I have found in practice that the most available surface for phonogram-blanks and phonograms is one composed of wax, gum, or other plastic hydrocarbon. Such compounds, however, I find contract and expand under variations of temperature to a much greater extent than paper, wood, metals, and other similar hard substances. While under ordinary conditions the wax or wax-like surface may not be injured by this difference in the coefficient of expansion, yet when subjected to extreme cold the contraction of the wax is so much greater than the harder backing that the wax will crack and destroy the continuity of the surface. For instance, a phonogram-blank or phonogram may be subjected to a temperature of nearly 100° Fahrenheit at one time and at another time the temperature may fall below zero. If the waxy substance is sufficiently hard at the high temperature to hold its shape under the pressure of one on the other in a packing-box, it will at the low temperature harden and contract so greatly in excess of the backing of harder material that the wax will crack and render the surface useless.

The object I have in view is to produce a phonogram-blank or phonogram which will have the wax or wax-like surface and will not be subject to the objection that has been stated. This I accomplish by constructing the phonogram-blank or phonogram wholly of the wax or wax-like material. I prefer to mold the entire phonogram-blank of the one wax-like compound; but I may construct the base or

backing of the surface of a somewhat different mixture of wax or wax-like materials than that of which the surface is made, so long as the whole has substantially the same coefficient of expansion.

My phonogram-blank I prefer to mold as a hollow cylinder with a tapering bore for slipping over the tapering phonogram-cylinder of my phonograph.

In the accompanying drawings, forming a part hereof, Figure 1 is an elevation of the phonogram-blank; Fig. 2, a longitudinal section thereof, and Fig. 3 an end view.

A is the cylindrical phonogram-blank, molded of the plastic wax or wax-like material, as described, and having a tapering bore.

The invention is also applicable to duplicate phonograms having the phonographic record thereon.

What I claim is—

1. A phonogram blank or phonogram constructed wholly of wax or wax-like materials and having the same coefficient of expansion throughout its mass, substantially as set forth.

2. A phonogram-blank or phonogram constructed as a hollow cylinder wholly of wax or wax-like materials and having the same coefficient of expansion throughout its mass, substantially as set forth.

3. A phonogram-blank or phonogram constructed as a hollow cylinder, with a tapering bore wholly of wax or wax-like materials, and having the same coefficient of expansion throughout its mass, substantially as set forth.

This specification signed and witnessed this 5th day of December, 1887.

THOS. A. EDISON.

Witnesses:

WILLIAM PELZER,  
E. C. ROWLAND.





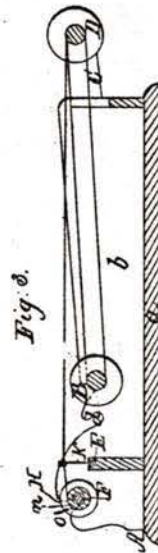
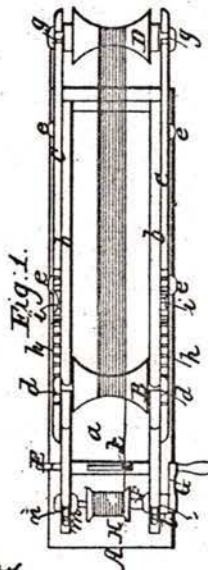
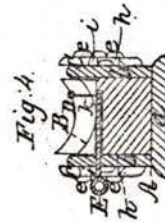
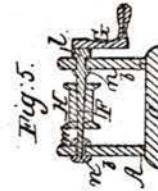
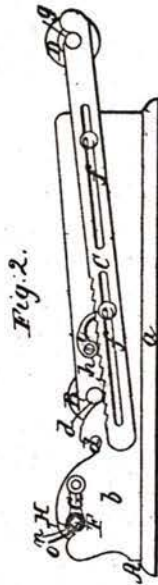




A. S. PHILLIPS.  
APPARATUS FOR SPOOLING THREAD.

No. 70,113.

Patented Oct. 22, 1867.



Witnesses  
Geo. H. Andrews  
Lamitz Miller

Inventor  
Alfred S Phillips  
by his attorney  
V. H. Hedy

# United States Patent Office.

ALFRED S. PHILLIPS, OF SOUTH BOSTON, MASSACHUSETTS.

*Letters Patent No. 70,113, dated October 22, 1867.*

## IMPROVEMENT IN APPARATUS FOR SPOOLING THREAD.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL PERSONS TO WHOM THESE PRESENTS MAY COME:

Be it known that I, ALFRED S. PHILLIPS, of South Boston, in the county of Suffolk, and State of Massachusetts, have invented a new and useful or improved Apparatus for Balling or Spooling Thread from a skein; and do hereby declare the same to be fully described in the following specification, and represented in the accompanying drawings, of which—

Figure 1 is a top view,

Figure 2 a side elevation, and

Figure 3 a longitudinal section of it.

Figure 4 is a transverse section of it, such being taken through its movable thread-guide.

Figure 5 is another transverse section of it, such being taken through the axis of its spool.

In such drawings, A denotes the frame of the machine, as mainly composed of a base-plate, *a*, and two parallel standards or plates *b b*, the latter being erected on the base-plate. Each of these plates *b b* is notched, as shown at *d d*, for the reception of the journals of a roller, B, arranged in one pair of the notches, as represented. To the outer side of each plate *b* a bar, C, is applied, by means of pins or bolts *e e* going through slots *ff* made in the bar, such pins being projected from the plate *b*. Near its outer end each of such bars C is notched, as shown at *g*, so as to receive one of the journals of another roller, D, arranged between the bars in manner as shown in figs. 1 and 2. Each of the bars C has a series of notches or teeth, as shown at *h*, they being to operate with a retaining-pawl, *i*, placed over the bar and against the next adjacent plate *b*.

A skein of thread or yarn being placed on and around the two rollers, the two bars C C are to be drawn outward until such skein may be tight upon the rollers, the pawls *i*, by dropping into the notches or against the teeth, serving, with such, to keep the bars extended or in place.

In rear of the first-mentioned roller is a slider, E, carrying a guide, *k*, such slider being supported so as to enable it to be moved both back and forth transversely of the frame. In rear of the slider is a tapering shaft, F, provided with a crank, G. This shaft has one fixed journal *l*, and one movable journal *m*, the latter being so made and applied to the shaft as to be capable of being removed from it to enable a spool, H, to be placed on the shaft, by forcing the latter through the spool axially. The two journals of the shaft are supported in notches *n n* made in the plates *b b*, and are kept in place by means of springs *o o* applied to such notches, or arranged with respect to them in manner as represented in the drawings.

When the apparatus is to be used, the end of the thread from the skein should be passed through the guide of the slider, and carried to the cranked shaft, or to a spool when thereon. By revolving the shaft with one hand applied to its crank, and by moving the slider with the other hand, as occasion may require, a person may readily reduce the skein to a ball or wind it upon the spool.

The apparatus, so made, takes up less room than the common "swift," when expanded, and, besides, is far more convenient for use.

I claim as my invention—

The arrangement, as well as the combination, of the two rollers B D, the frame A, the adjustable bars C C, provided with notches or teeth *h* and pawls *i*, as described, the slider E and its guide *k*, and the cranked shaft F, the whole being substantially as specified.

I also claim the combination of the movable journal *m* with the cranked shaft F and its stationary journal *l*, as set forth

ALFRED S. PHILLIPS.

Witnesses:

R. H. EDDY,

F. P. HALE, Jr.





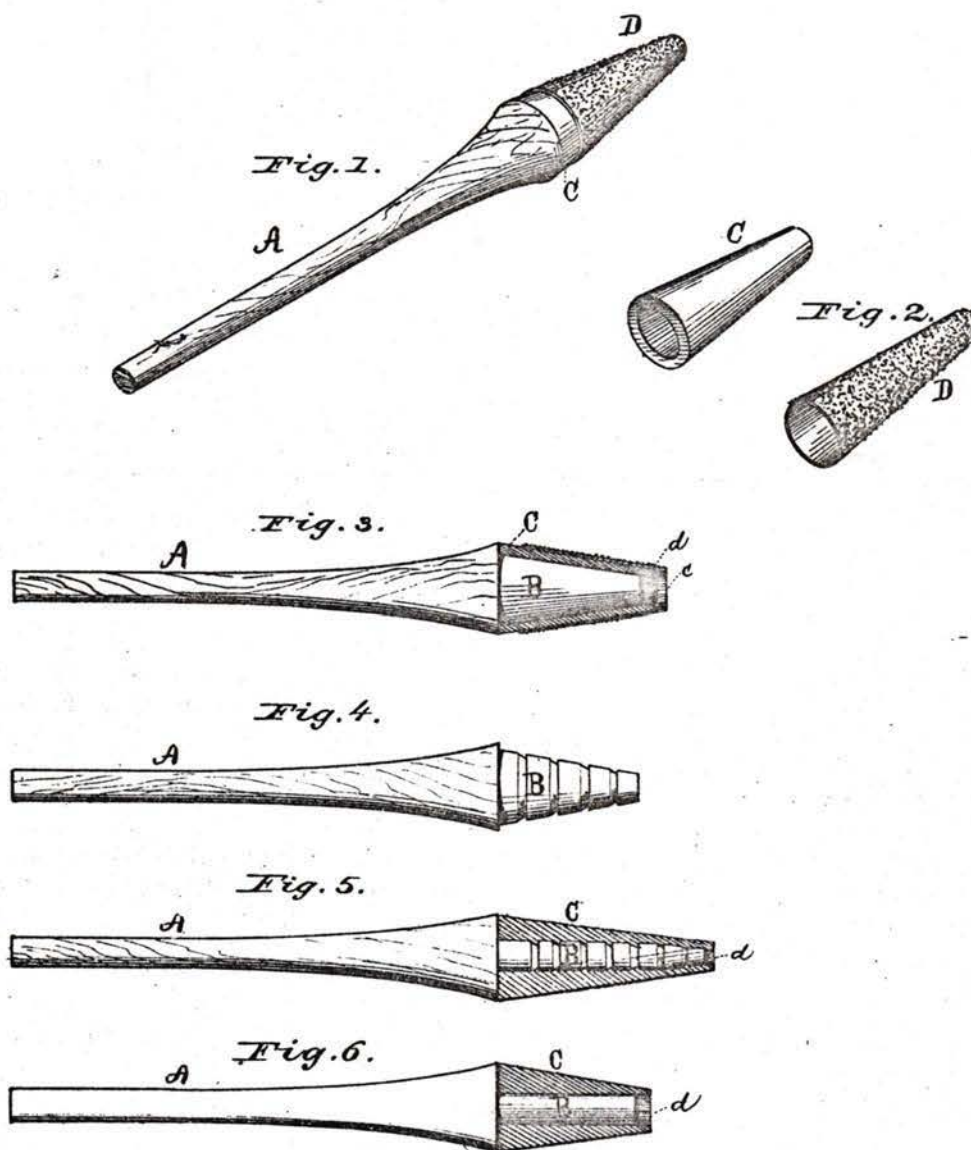




L. F. LOCKE.  
DENTAL POLISHING-TOOL.

No. 170,178.

Patented Nov. 23, 1875.



Attest:  
H. L. Smith  
J. E. Marshall

Inventor.  
Luther F. Locke

# UNITED STATES PATENT OFFICE.

LUTHER F. LOCKE, OF NASHUA, NEW HAMPSHIRE.

## IMPROVEMENT IN DENTAL POLISHING-TOOLS.

Specification forming part of Letters Patent No 170,178, dated November 23, 1875; application filed June 22, 1875.

### *To all whom it may concern:*

Be it known that I, L. F. LOCKE, of Nashua, New Hampshire, have invented certain new and useful improvements in implements for cutting, trimming, shaping, and polishing plates for artificial teeth, of which the following is a full, clear, and exact description, reference being had to the drawing making part of this application.

My invention consists of an implement or tool which may be mounted in the dental lathe. It is composed of several parts, viz: a spindle to fit the lathe-head, an elastic conical cushion, and a collar fitting tightly over the latter, and projecting somewhat beyond the end of the supporting-cushion, said collar being composed of sand-paper, emery, or other similar substance. The construction of these parts and their relation to each other are novel and peculiar and will be best understood from the drawing.

Figure 1 shows the device complete. Fig. 2 shows the conical elastic cushion and sand-paper collar detached. Fig. 3 is a longitudinal section of the device, as shown in Fig. 1. Fig. 4 shows the spindle. Figs. 5 and 6 show various forms of the spindle, with the elastic cushion attached.

A is the shank of the spindle, the size and shape being adapted to fit the common lathe-head. B is the head, which may be made conical, and corrugated, as shown in Fig. 4, or straight and smooth, as seen in Fig. 6. C is the elastic cushion, which is, preferably, made of rubber, conical in form, and bored completely through, as shown in Fig. 6. D is the sand-paper collar, which is made to fit the cushion tightly, the several parts thus named being all constructed so that they may easily be detached from each other, and new ones supplied, as wear or injury may require.

All dentists are familiar with the difficulty experienced in shaping and polishing the plates used to support artificial teeth. Not only is the material of which they are composed hard to cut, but the peculiar shape of the plates, and the numerous angles, the minute cavities, and the delicately-formed sinuses,

each requiring to be shaped and polished, renders the task one of great labor, and requiring long practice and patience.

The object of my invention is to provide a tool which will shape and polish every part of the plate, and thus avoid the difficulties named.

To this end I allow the elastic cushion to project slightly beyond the end of the spindle-head, as shown in Fig. 6. Now, if the sand-paper collar terminates exactly at the extremity of the cushion it will be seen that an extremely sharp and delicate cutting-edge is obtained, which will readily enter the sinus between two of the teeth upon the plate. Nor is this all; for, by pressing the plate against the end of the cone, at an angle to the axis of the spindle, the unsupported end of the cushion will bend in against the end of the spindle, and, by the rapid rotation of the latter, a sharply-convex polishing-surface is formed, which will enter minute depressions and cavities with ease. When the pressure is removed the rubber cushion will again resume its usual position.

This result may be better attained by arranging the parts, as shown in Fig. 3, allowing the polishing-collar to project beyond the rubber cone about as far as the latter projects beyond the end of the spindle. I much prefer this construction, although either may be used.

The form of the elastic cushion will readily commend itself to any operator, although I claim no novelty therein. The conical surface will cut the material composing the artificial plate with great rapidity.

After the plate is cut down and trimmed to the necessary dimensions and shape the collar may be removed, and upon the surface of the elastic cushion some fine polishing material may be lightly sprinkled. The plate being then applied will be polished most brilliantly in a few moments.

What I claim, and desire to secure by Letters Patent, is—

1. In the dental polishing-tool described, the conical elastic cushion C, adapted to fit the spindle-head B, and having the annulus d



projecting beyond the extremity of the spindle B, as and for the purpose described.

2. In a dental polishing-tool, such as described, an elastic, conical cushion, C, having its extremity *d* projecting beyond the end of the spindle, and covered by a sand-paper collar, which has a portion, *c*, extending beyond

the end of the cushion, substantially as and for the purpose set forth.

LUTHER F. LOCKE.

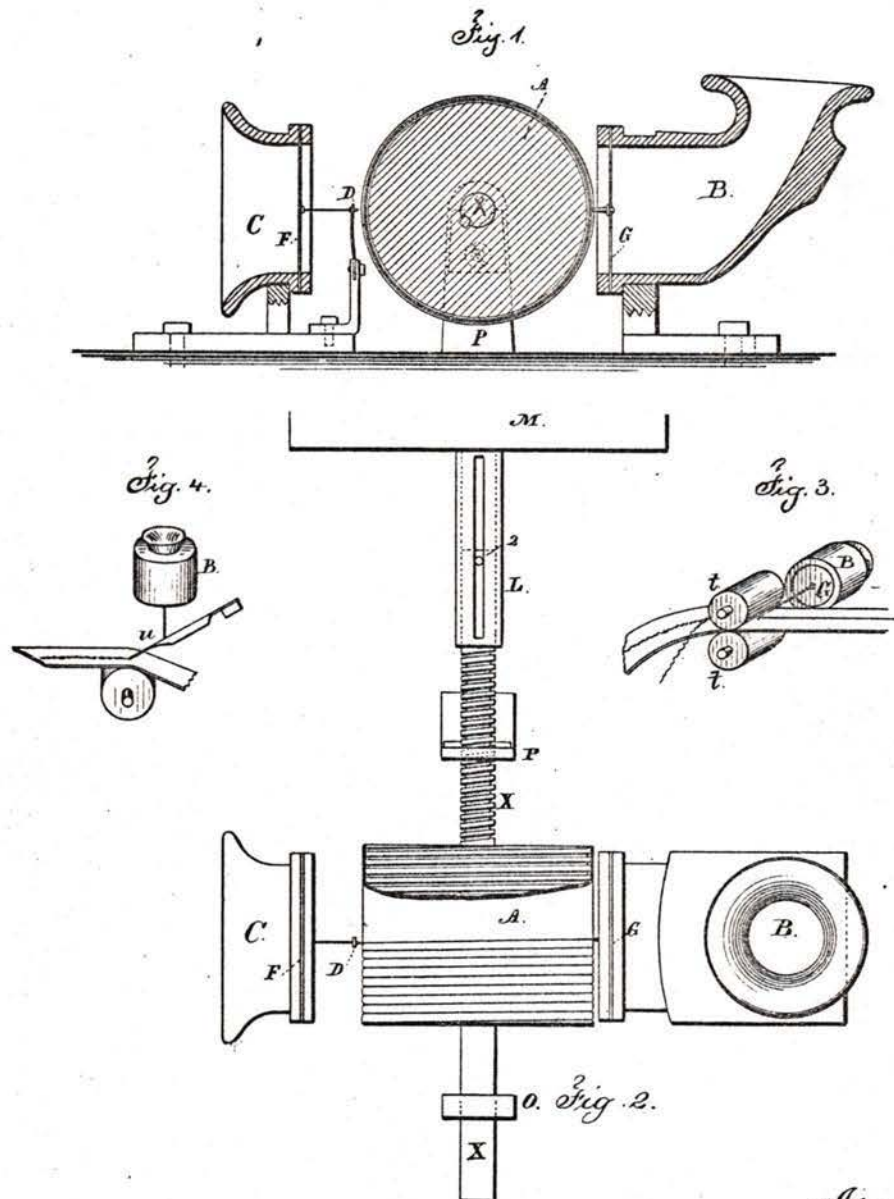
Witnesses:

R. T. SMITH,  
JOHN TAYLOR.





T. A. EDISON.  
Phonograph or Speaking Machine.  
No. 200,521.                      Patented Feb. 19, 1878.



Witnesses

Charles H. Smith,  
Harold Purcell

Inventor

Thomas A. Edison.

per Lemuel W. Serrell  
att'y

# UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

## IMPROVEMENT IN PHONOGRAPH OR SPEAKING MACHINES.

Specification forming part of Letters Patent No. 200,521, dated February 19, 1878; application filed December 24, 1877.

### *To all whom it may concern:*

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Phonograph or Speaking Machines, of which the following is a specification:

The object of this invention is to record in permanent characters the human voice and other sounds, from which characters such sounds may be reproduced and rendered audible again at a future time.

The invention consists in arranging a plate, diaphragm, or other flexible body capable of being vibrated by the human voice or other sounds, in conjunction with a material capable of registering the movements of such vibrating body by embossing or indenting or altering such material, in such a manner that such register-marks will be sufficient to cause a second vibrating plate or body to be set in motion by them, and thus reproduce the motions of the first vibrating body.

The invention further consists in the various combinations of mechanism to carry out my invention.

I have discovered, after a long series of experiments, that a diaphragm or other body capable of being set in motion by the human voice does not give, except in rare instances, superimposed vibrations, as has heretofore been supposed, but that each vibration is separate and distinct, and therefore it becomes possible to record and reproduce the sounds of the human voice.

In the drawings, Figure 1 is a vertical section, illustrating my invention, and Fig. 2 is a plan of the same.

A is a cylinder having a helical indenting-groove cut from end to end—say, ten grooves to the inch. Upon this is placed the material to be indented, preferably metallic foil. This drum or cylinder is secured to a shaft, X, having at one end a thread cut with ten threads to the inch, the bearing P also having a thread cut in it.

L is a tube, provided with a longitudinal slot, and it is rotated by the clock-work at M, or other source of power.

The shaft X passes into the tube L, and it is rotated by a pin, 2, secured to the shaft, and passing through the slot on the tube L,

the object of the long slot being to allow the shaft X to pass endwise through the center or support P by the action of the screw on X. At the same time that the cylinder is rotated it passes toward the support O.

B is the speaking-tube or mouth-piece, which may be of any desired character, so long as proper slots or holes are provided to re-enforce the hissing consonants. Devices to effect this object are shown in my application, No. 143, filed August 28, 1877. Hence they are not shown or further described herein.

Upon the end of the tube or mouth-piece is a diaphragm, having an indenting-point of hard material secured to its center, and so arranged in relation to the cylinder A that the point will be exactly opposite the groove in the cylinder at any position the cylinder may occupy in its forward rotary movement.

The speaking-tube is arranged upon a standard, which, in practice, I provide with devices for causing the tube to approach and recede from the cylinder.

The operation of recording is as follows: The cylinder is, by the action of the screw in X, placed adjacent to the pillar P, which brings the indenting-point of the diaphragm G opposite the first groove on the cylinder, over which is placed a sheet of thick metallic foil, paper, or other yielding material. The tube B is then adjusted toward the cylinder until the indenting-point touches the material and indents it slightly. The clock-work is then set running, and words spoken in the tube B will cause the diaphragm to take up every vibration, and these movements will be recorded with surprising accuracy by indentations in the foil.

After the foil on the cylinder has received the required indentations, or passed to its full limit toward O, it is made to return to P by proper means, and the indented material is brought to a position for reproducing and rendering audible the sounds that had been made by the person speaking into the tube B.

C is a tube similar to B, except that the diaphragm is somewhat lighter and more sensitive, although this is not actually necessary. In front of this diaphragm is a light spring, D, having a small point shorter and finer than the indenting-point on the diaphragm of B. This spring and point are so arranged as to fall



exactly into the path of all the indentations. This spring is connected to the diaphragm F of C by a thread or other substance capable of conveying the movements of D. Now, when the cylinder is allowed to rotate, the spring D is set in motion by each indentation corresponding to its depth and length. This motion is conveyed to the diaphragm either by vibrations through a thread or directly by connecting the spring to the diaphragm F, and these motions being due to the indentations, which are an exact record of every movement of the first diaphragm, the voice of the speaker is reproduced exactly and clearly, and with sufficient volume to be heard at some distance.

The indented material may be detached from the machine and preserved for any length of time, and by replacing the foil in a proper manner the original speaker's voice can be reproduced, and the same may be repeated frequently, as the foil is not changed in shape if the apparatus is properly adjusted.

The record, if it be upon tin-foil, may be stereotyped by means of the plaster-of-paris process, and from the stereotype multiple copies may be made expeditiously and cheaply by casting or by pressing tin-foil or other material upon it. This is valuable when musical compositions are required for numerous machines.

It is obvious that many forms of mechanism may be used to give motion to the material to be indented. For instance, a revolving plate may have a volute spiral cut both on its upper and lower surfaces, on the top of which the foil or indenting material is laid and secured in a proper manner. A two-part arm is used with this disk, the portion beneath the disk having a point in the lower groove, and the portion above the disk carrying the speaking and receiving diaphragmic devices, which arm is caused, by the volute spiral groove upon the lower surface, to swing gradually from near the center to the outer circumference of the plate as it is revolved, or vice versa.

An apparatus of this general character adapted to a magnet that indents the paper is shown in my application for a patent, No. 128, filed March 26, 1877; hence no claim is made herein to such apparatus, and further description of the same is unnecessary.

A wide continuous roll of material may be used, the diaphragmic devices being reciprocated by proper mechanical devices backward and forward over the roll as it passes forward; or a narrow strip like that in a Morse register may be moved in contact with the indenting-point, and from this the sounds may be reproduced. The material employed for this purpose may be soft paper saturated or coated with paraffine or similar material, with a sheet of metal foil on the surface thereof to receive the impression from the indenting-point.

I do not wish to confine myself to reproducing sound by indentations only, as the trans-

mitting or recording device may be in a sinuous form, resulting from the use of a thread passing with paper beneath the pressure-rollers *t*, (see Fig. 3,) such thread being moved laterally by a fork or eye adjacent to the roller *t*, and receiving its motion from the diaphragm G, with which such fork or eye is connected, and thus record the movement of the diaphragm by the impression of the thread in the paper to the right and left of a straight line, from which indentation the receiving-diaphragm may receive its motion and the sound be reproduced, substantially in the manner I have already shown; or the diaphragm may, by its motion, give more or less pressure to an inking-pen, *u*, Fig. 4, the point of which rests upon paper or other material moved along regularly beneath the point of the pen, thus causing more or less ink to be deposited upon the material, according to the greater or lesser movement of the diaphragm. These ink-marks serve to give motion to a second diaphragm when the paper containing such marks is drawn along beneath the end of a lever resting upon them and connected to such diaphragm; the lever and diaphragm being moved by the friction between the point being greatest, or the thickness of the ink being greater where there is a large quantity of ink than where there is a small quantity. Thus the original sound-vibrations are reproduced upon the second diaphragm.

I claim as my invention—

1. The method herein specified of reproducing the human voice or other sounds by causing the sound-vibrations to be recorded, substantially as specified, and obtaining motion from that record, substantially as set forth, for the reproduction of the sound-vibrations.

2. The combination, with a diaphragm exposed to sound-vibrations, of a moving surface of yielding material—such as metallic foil—upon which marks are made corresponding to the sound-vibrations, and of a character adapted to use in the reproduction of the sound, substantially as set forth.

3. The combination, with a surface having marks thereon corresponding to sound-vibrations, of a point receiving motion from such marks, and a diaphragm connected to said point, and responding to the motion of the point, substantially as set forth.

4. In an instrument for making a record of sound-vibrations, the combination, with the diaphragm and point, of a cylinder having a helical groove and means for revolving the cylinder and communicating an end movement corresponding to the inclination of the helical groove, substantially as set forth.

Signed by me this 15th day of December, A. D. 1877.

THOS. A. EDISON.

Witnesses:

GEO. T. PINCKNEY,  
CHAS. H. SMITH.





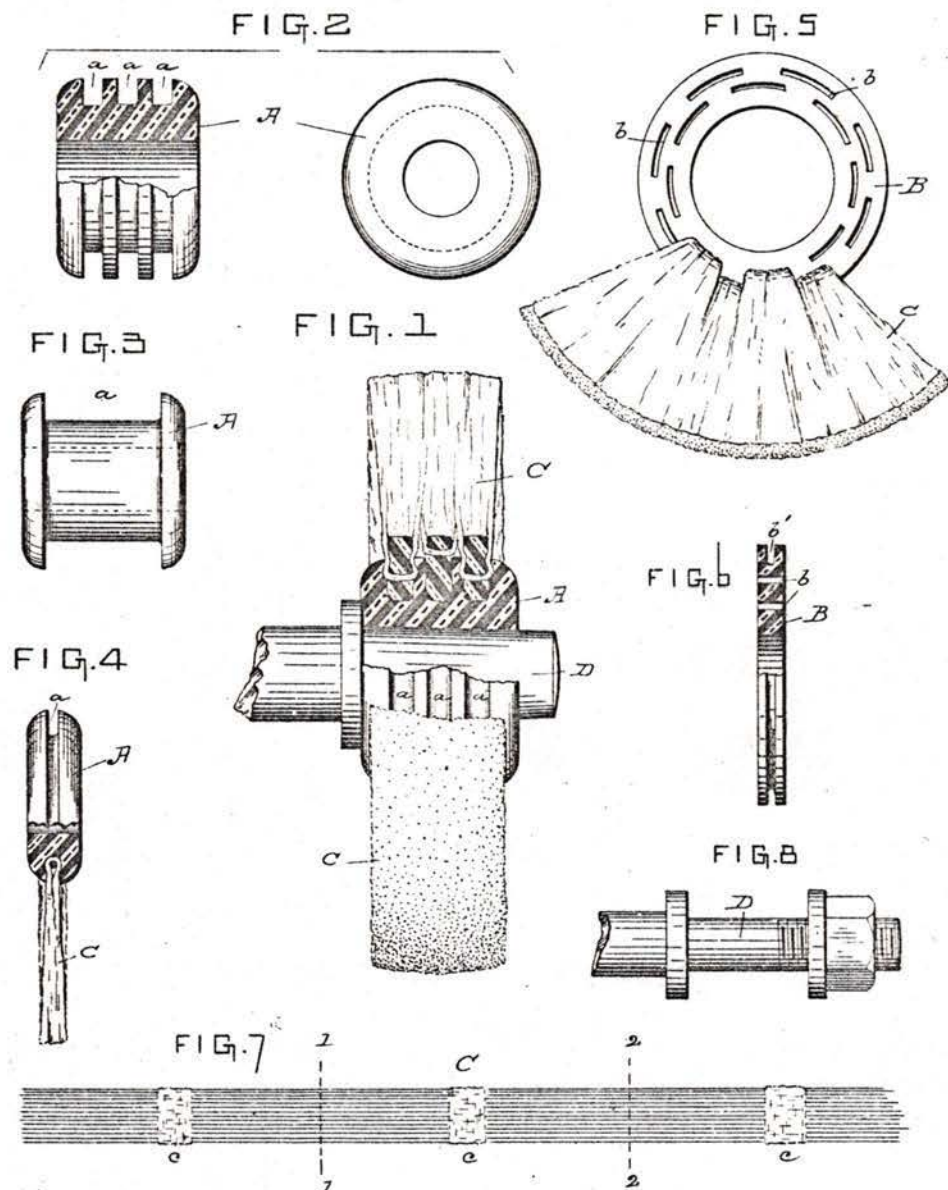
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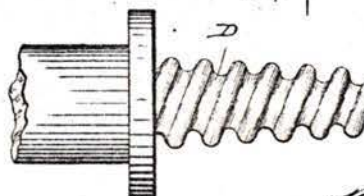
J. R. ABBE.  
BUFFING WHEEL.

No. 277,097.

Patented May 8, 1883.



Witnesses  
Henry A. Hales  
Chas. M. Johns



Inventor  
John R. Abbe  
By Charles E. Allen  
his atty





(Model.)

4 Sheets—Sheet 2.

J. R. ABBE.  
BUFFING WHEEL.

No. 277,097.

Patented May 8, 1883.

FIG. 10

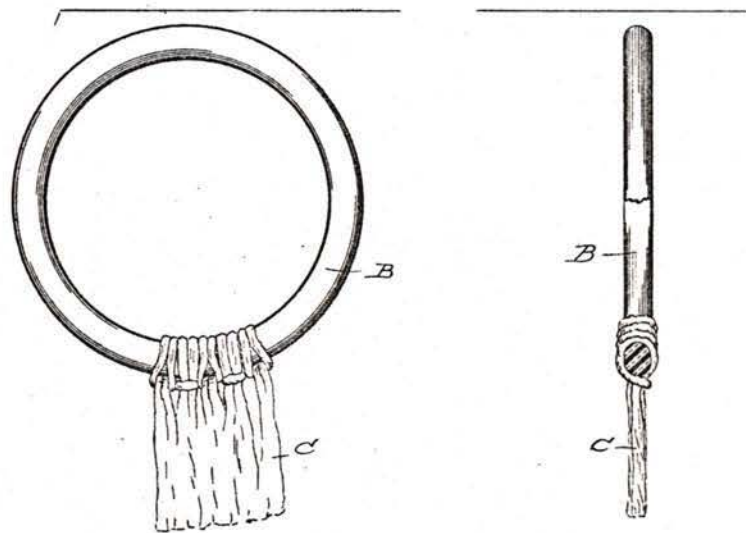


FIG. 11

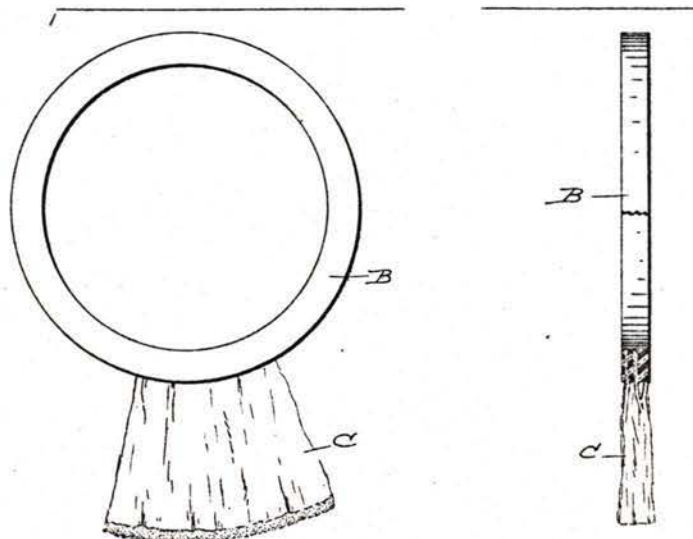
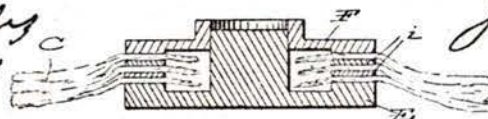


FIG. 12



Witnesses

Henry A. Guly  
Chas. M. Polanco

Inventor

John R. Abbe.  
By Chas. B. Abbe  
Att'y.





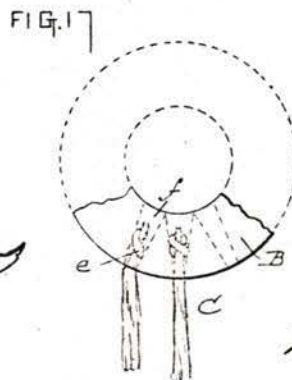
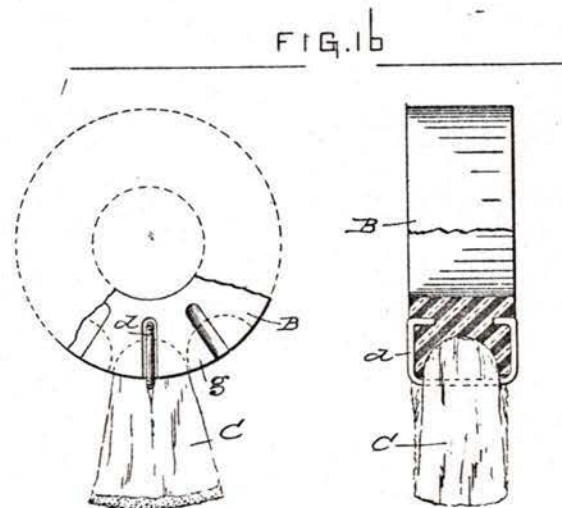
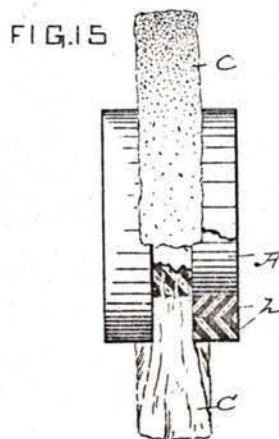
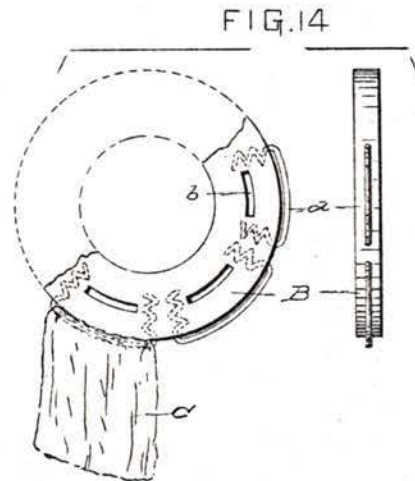
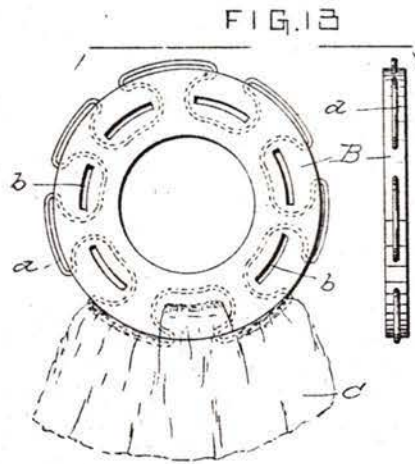
(Model.)

4 Sheets—Sheet 3.

J. R. ABBE.  
BUFFING WHEEL.

No. 277,097.

Patented May 8, 1883.



Witnesses  
Henry A. Hales  
Chas. M. Palmer

Inventor  
John R. Abbe,

By Chas. C. Abbe  
his Atty





(Model.)

4 Sheets—Sheet 4.

J. R. ABBE.  
BUFFING WHEEL.

No. 277,097.

Patented May 8, 1883.

FIG 18.

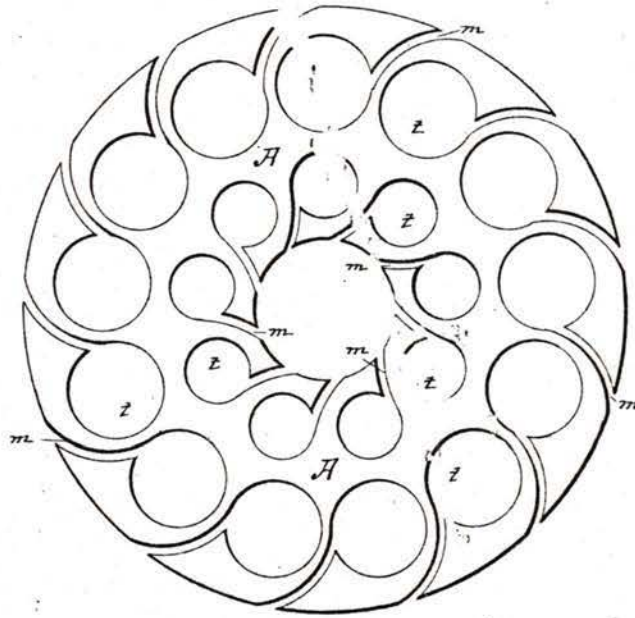
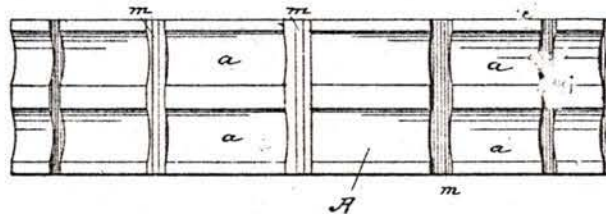


FIG 19.



Witnesses.  
David H. Dustin  
Wm. R. Forsaiter

Inventor.  
John R. Abbe.  
By Chas. C. Abbe  
Att'y

# UNITED STATES PATENT OFFICE.

JOHN R. ABBE, OF SOUTH WINDHAM, CONNECTICUT.

## BUFFING-WHEEL.

SPECIFICATION forming part of Letters Patent No. 277,097, dated May 8, 1883.

Application filed February 9, 1883. (Model.)

*To all whom it may concern:*

Be it known that I, JNO. R. ABBE, of South Windham, in the county of Windham and State of Connecticut, have invented a new and  
5 useful Improvement in Buffing-Wheels, which improvement is fully set forth in the following specification and accompanying drawings, in which—

Figure 1 is a part-sectional and part-f 1  
10 view of my improved buffing-wheel; Fig. 2, a side and end view of the hub or body-support for buffing-fibers. Figs. 3 and 4 are modified forms of above-mentioned hub. Figs. 5 and 6  
15 are side and edge views of ring for holding buffing material; Fig. 7, a plan view, showing form in which the buffing-fibers are woven; Figs. 8 and 9, views of various forms of mandrels for holding the hub; Figs. 10, 11, 13, 14,  
20 16, and 17, various forms of elastic rings for holding the buffing-fibers; Fig. 12, a sectional view of a mold for forming the rings which hold the buffing-fibers; Fig. 15, a front view of a buffing-wheel with rings adapted to reduce the width of buffing-fibers; Figs. 18 and 19, a  
25 side and edge view of a modified hub so formed as to be elastic.

The object of my invention is to furnish a fibrous buffing-wheel which can be easily made, is cheap in construction, and adapted to fill  
30 the place of all those now in use.

As shown in the drawings, A is an annular elastic hub made of rubber or other material, and so constructed as to be directly applied to a mandrel from which it is to receive its rota-  
35 tive motion. On its exterior surface there is formed a groove or grooves, *a*, so formed as to receive the annular rings B, to which the buffing-fibers are attached. The grooves *a* are of any depth desirable, and form ribs between  
40 each other, which support the fibers attached to the rings B, which are elastic and formed in various ways, as shown by the several views. In Fig. 5 is shown a perforated ring with perforations *b b*, in which the buffing-fibers  
45 are placed in gangs. The said gangs of fibers overlapping each other, as shown, causes the fibers to form a solid body, so to speak, of buffing material.

In Figs. 13, 14, and 16 I have shown these  
50 elastic rings re-enforced by a spring-wire, *d*,

the object of which is to retain the ring in compact form should there be a tendency to expand when revolving at a high rate of speed. In Fig. 16 there are pockets *g*, formed in the ring, and the wires *d* are placed across the  
55 pockets to retain the fibers. In Fig. 17 the pockets are formed on the inside, and are of wedge shape. Through these openings the fibers are drawn, and prevented from passing entirely through by knots on the same. In  
60 Fig. 10 there is shown a solid ring with the buffing-fibers looped or caught up by a noose. In Fig. 11 the fibers C are shown embedded in the elastic material which forms the ring B, and in Fig. 12 I show the former or die for making  
65 such rings, E being the lower half of the die, with an upright teat or projection at the center. Between the fibers C are placed annular plates *i*, and on top of all is placed the cap F. The rubber being run into the die when  
70 in this condition hardens around the fibers and holds them securely. In Fig. 15 are shown annular rings or reducers *h*, which are placed one on top of the other to reduce the width of face of polishing-surface without taking off or adding to the hub the rings B. The buffing-fibers  
75 I make of woven or twisted asbestos, as such I find (through its peculiar formation) especially adapted to buffing purposes where such fibers are used in gangs, as shown in Figs. 5, 8, 13, 14, and 16. I would prefer to make or weave the same as shown in Fig. 7, where the warp C is formed of asbestos and connected or woven together at proper intervals by the ordinary filling-threads made of cotton, hemp, as-  
85 bestus, or other material suitably adapted to the same purpose, as at *e*. When these fibers are to be applied to the rings they are cut into lengths, as at 1 1 and 2 2, and drawn into the ring as far as that portion which is woven, thus forming a solid body for abrasive purposes when  
90 enough have been drawn through. To the fibers I prefer to attach by means of some adhesive material fine abrasive powders—such as rouge, flower of emery, &c.—which will act with  
95 the fibers in polishing.

In operation the hub A is placed upon a mandrel, D, which may be of various forms, and adapted to revolve at a high rate of speed. The rings B are slipped over the hub until a  
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sufficient thickness of fibers is obtained, and all is ready for work. If, while in use, the width of polishing-surface is desired to be reduced, the rings *h* are added one on top of the other, the width growing less as each additional layer is added.

With this construction there are no metallic parts to come in contact with articles being polished and injure the same, the rubber parts overcoming all previous objections.

In describing my construction I do not wish it understood that I limit myself to the exact construction shown—as, for instance, the central hub may be made of wood or metal, Figs. 18 and 19, with a series of holes, *tt*, around the inner and outer circumferences; and parallel with the axis of the hub, radiating from these openings *tt*, are slots *mm*, opening through to the inner or outer circumference and eccentric to the axis of the hub, thus forming a spring-like body in such construction. The reinforcing wire may be either zizzag or in spiral form. It may be placed in lines parallel with the axis of the hub, or in two or more continuous rows in planes at right angles to its axis. Strong fibers of paper or cloth impregnated with polishing-powders may be used.

I am well aware that rubber has been used as a center for an emery-wheel, but not as a hub, the object being to prevent chattering of the emery-wheel when in use. I therefore disclaim the same; but

What I desire to claim and secure by Letters Patent is—

1. A fibrous buffing-wheel provided with a self-supporting elastic hub whose exterior surface is recessed, as and for the purpose set forth.

2. A perforated annular ring composed of elastic material, to which the fibrous buffing material is attached.

3. An annular perforated ring composed of elastic material, which is re-enforced by a wire through the same, as and for the purpose set forth.

4. A fibrous buffing-wheel provided with an elastic hub, in combination with an elastic ring to which the fibrous buffing material is attached, as and for the purpose set forth.

5. A buffing-wheel having the polishing-surface formed of fibers of asbestos, as and for the purpose set forth.

6. The polishing-fibers of a buffing-wheel, formed in continuous lengths and woven together at certain intervals, which are adapted to be cut in proper lengths when applied to use, as and for the purpose set forth.

JOHN R. ABBE.

Witnesses:

CHESTER TILDEN,  
JAMES M. BOWEN.





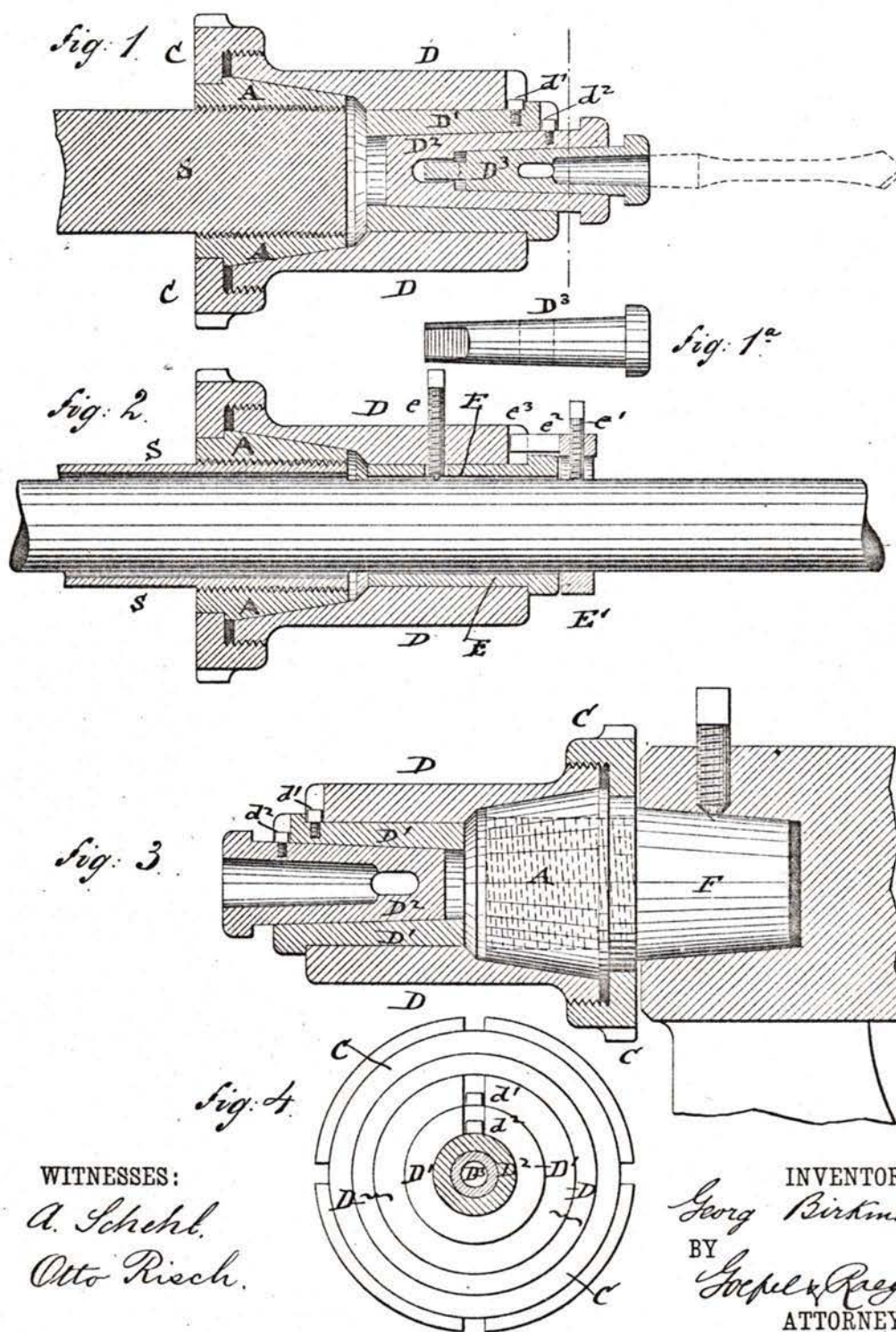
(No Model.)

G. BIRKMANN.

LATHE CHUCK.

No. 309,288.

Patented Dec. 16, 1884.



WITNESSES:

A. Schehl.  
Otto Risch.

INVENTOR

Georg Birkmann  
BY  
Jepel & Regener  
ATTORNEYS.



# UNITED STATES PATENT OFFICE.

307

GEORG BIRKMANN, OF NEW YORK, N. Y.

## LATHE-CHUCK.

SPECIFICATION forming part of Letters Patent No. 309,288, dated December 16, 1884.

Application filed June 18, 1884. (No model.)

*To all whom it may concern:*

Be it known that I, GEORG BIRKMANN, of the city, county, and State of New York, have invented certain new and useful Improvements in Lathe-Chucks, of which the following is a specification.

This invention has reference to an improved lathe-chuck for holding boring-tools and shafts for facing; and the invention consists of a lathe-chuck in which a conical sleeve is screwed on the solid or hollow spindle of the lathe, said sleeve being connected by a screw-collar with a cylindrical socket, the latter receiving a number of smaller sockets for holding the shanks of the different sizes of boring-drills, or bushings of different sizes for holding the shafts to be faced.

In the accompanying drawings, Figure 1 represents a vertical longitudinal section of my improved lathe-chuck, shown with a set of detachable sockets for the shanks of the different boring-tools. Fig. 1<sup>a</sup> is a side view of the smallest tool-socket detached. Fig. 2 is a vertical longitudinal section of the lathe-chuck arranged to support a shaft; Fig. 3, a vertical longitudinal section of the same, shown as attached rigidly to one of the tail-stocks of the lathe; and Fig. 4 is an end elevation of the chuck, partly in section on line *xx*, Fig. 1.

Similar letters of reference indicate corresponding parts.

A in the drawings represents a conical sleeve that corresponds in size to the diameter of the solid or hollow lathe-spindle S. The conical sleeve A is screwed by an interior screw-thread on the exteriorly-threaded spindle S, as shown in Figs. 1 and 2. The conical sleeve is turned off at the thicker end, so as to form a shoulder, *a*, for an angular screw-collar, C, the threaded forward-extending portion of which engages the threaded rear end of a cylindrical main socket, D, that is fitted by its rear end accurately to the conical sleeve A. The inner front part of the main socket D is made cylindrical, and adapted to receive either a set or nest of auxiliary sockets, D' D<sup>2</sup> D<sup>3</sup>, of different sizes, which are secured in position by set-screws *d' d<sup>2</sup> d<sup>3</sup>*, said sockets serving to receive the shanks of different sizes of drills or other boring-tools. The innermost socket, D<sup>3</sup>, has a flattened rear end, which fits into an extension-socket of the next larger

socket, D<sup>2</sup>, as shown in Figs. 1 and 1<sup>a</sup>, by which the socket D is retained in position in connection with the pressure of the work on the boring-tool without requiring a special set-screw.

When the chuck is desired to be used for facing shafts, one or more cylindrical bushings, E, are inserted into the main socket D, and retained therein by set-screws *e*, that also press upon the shaft, so as to retain the same in rigid position against longitudinal displacement, while axial displacement is prevented by a collar, E', and set-screw *e'*, the collar E' engaging by a lug, *e'*, a recess, *e<sup>2</sup>*, of the main socket D. The shaft to be faced in the lathe can thus be rigidly secured to the lathe-chuck and turned with the same, so as to be operated upon by the facing-tool.

In some cases it is desired to arrange the boring-tool in a fixed position on the lathe and conduct the work against the same. In this case the conical sleeve A is screwed upon a solid piece, F, secured to one of the tail-stocks of the lathe, as shown in Fig. 3.

The advantages of my improved lathe-chuck are, first, that it can be adapted for use with any size of lathe-spindles by providing conical sleeves A of different diameters; secondly, that it is adapted to perform different kinds of work, such as boring holes of different sizes, facing shafts of different sizes, &c.; and, lastly, that it can be used with any metal-working lathe in common use with little extra expense.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

The combination, with a lathe-spindle, of a conical sleeve screwed therein, a cylindrical main socket fitted to the sleeve, a screw-collar connecting the sleeve and main socket, and one or more auxiliary sockets or bushings screwed into the main socket and adapted to receive different sizes of boring-tools or support different sizes of shafts, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

GEORG BIRKMANN.

Witnesses:

PAUL GOEPEL,  
SIDNEY MANN.









(No Model.)

4 Sheets—Sheet 1.

C. A. BELL &amp; S. TAINTER.

RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 341,214.

Patented May 4, 1886.

Fig. 1.

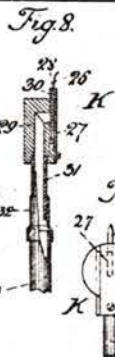
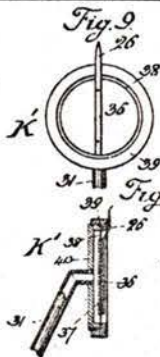
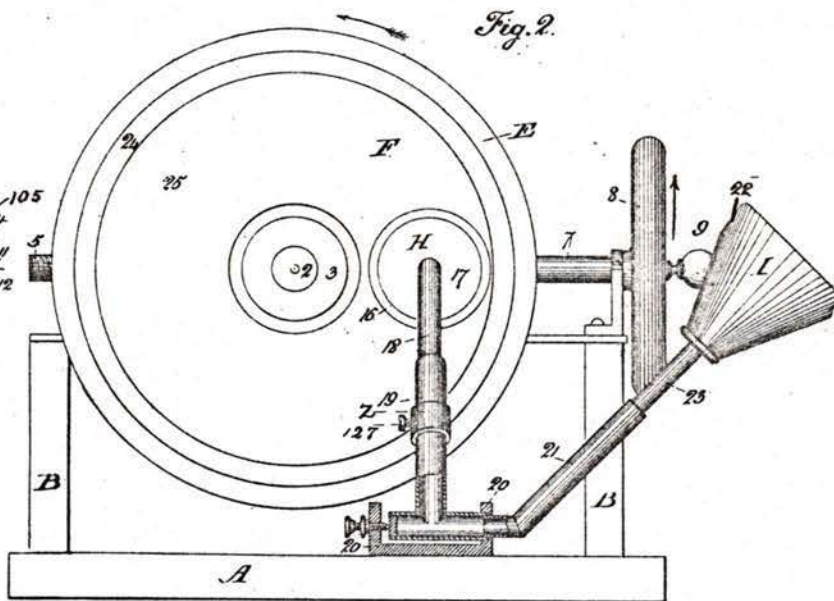
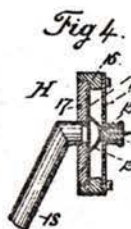
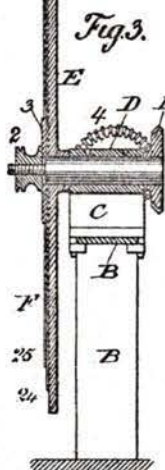
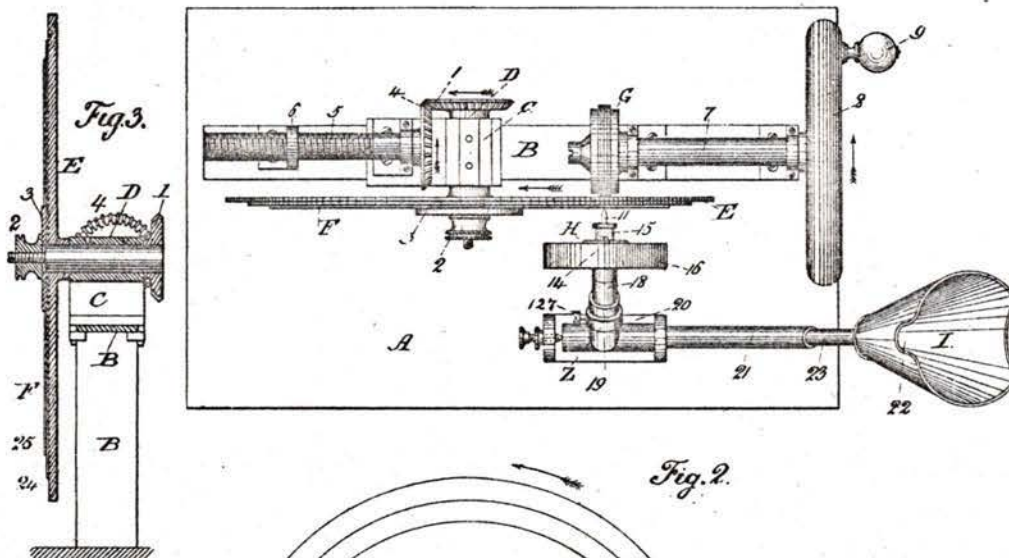


Fig. 11.

Witnesses  
 W. H. H. H.  
 C. J. Hedrick

Inventors  
 C. A. Bell & S. Tainter  
 by J. H. Bell  
 their attorney





(No Model.)

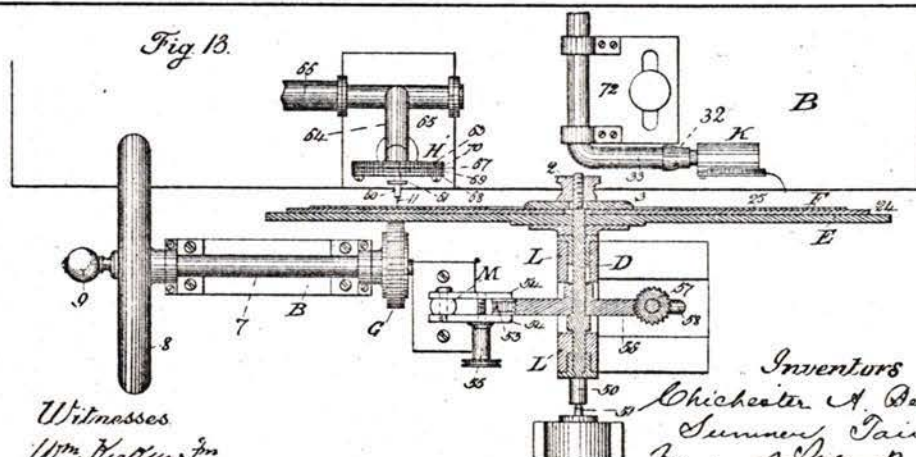
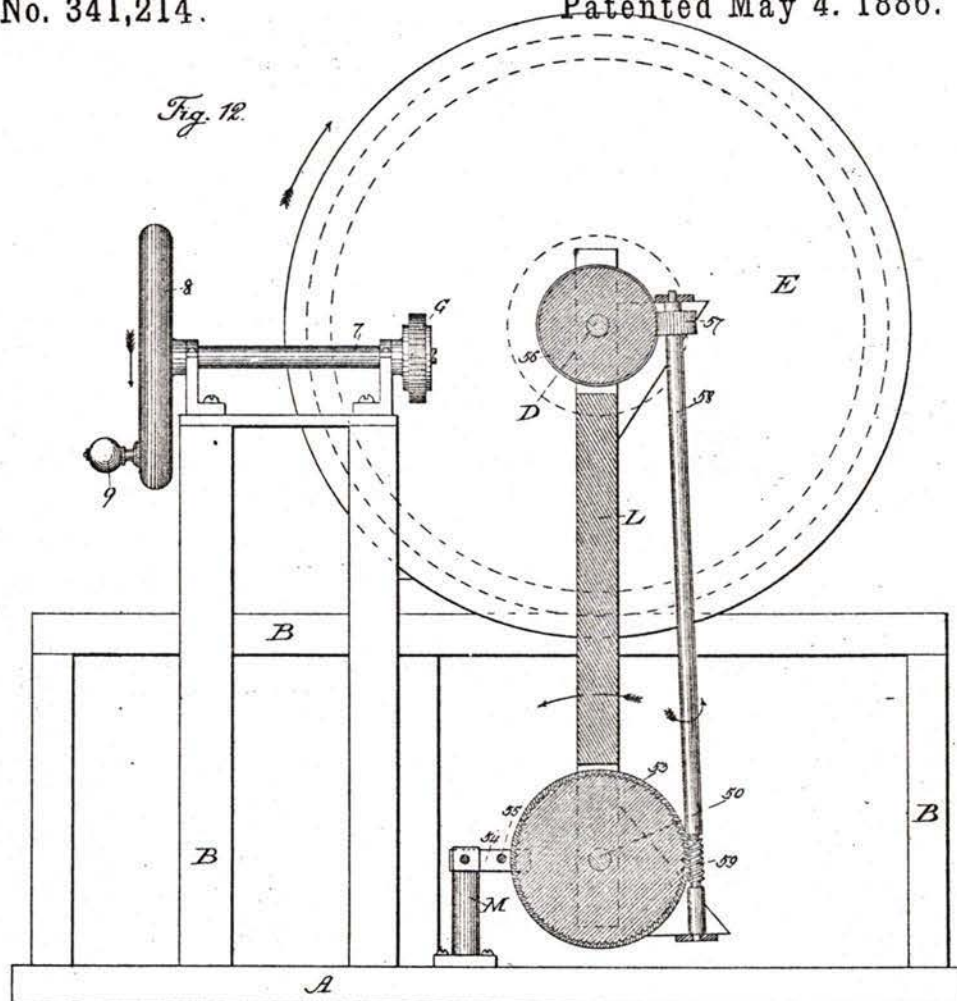
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C. A. BELL &amp; S. TAINTER.

RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 341,214.

Patented May 4. 1886.



Witnesses  
*Wm. Kirtley, Jr.*  
*C. J. Hedrick*

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*their attorney*





(No Model.)

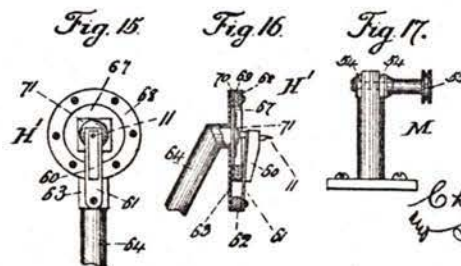
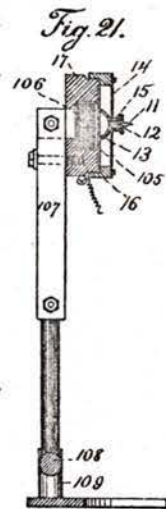
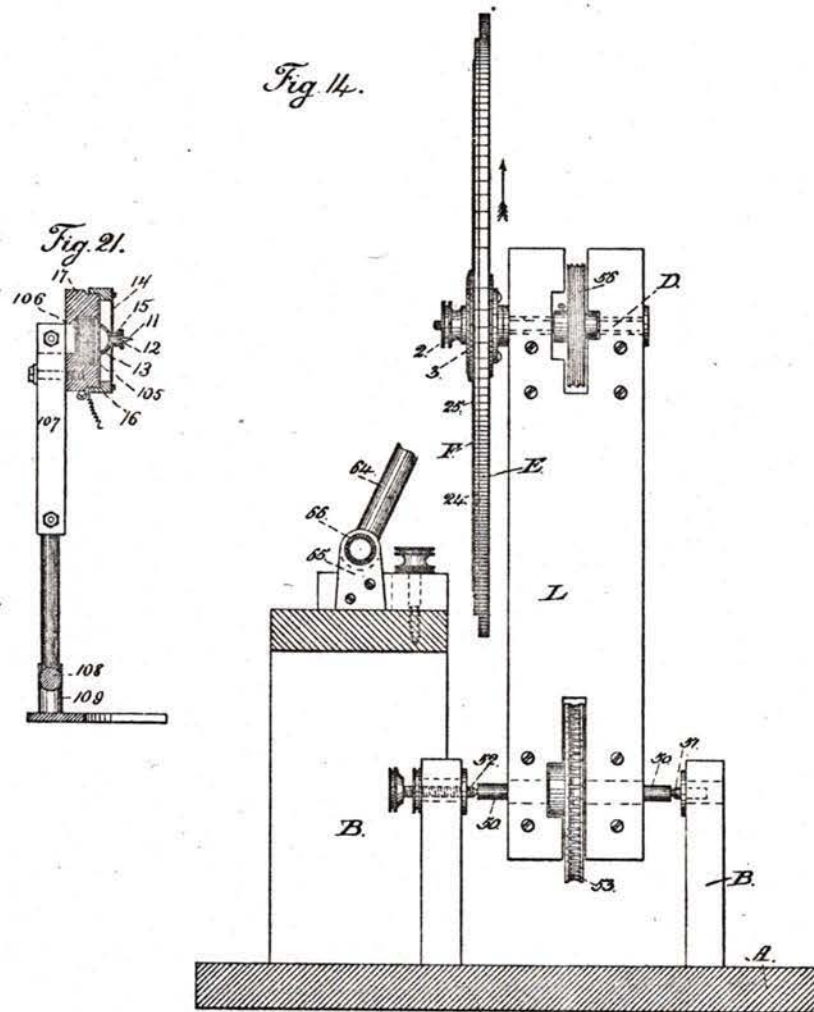
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C. A. BELL &amp; S. TAINTER.

RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 341,214.

Patented May 4, 1886.



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*C. J. Hedrick*

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*S. Tainter*  
 by *A. Pollard*  
*their attorney*





(No Model.)

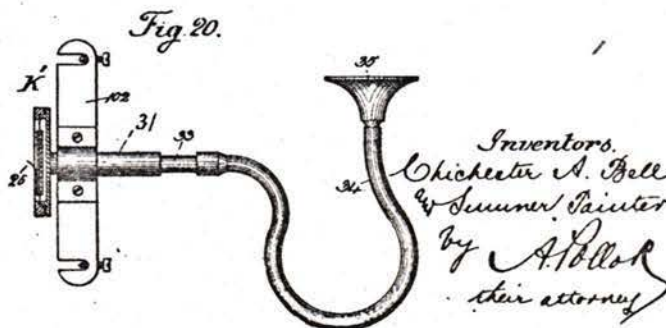
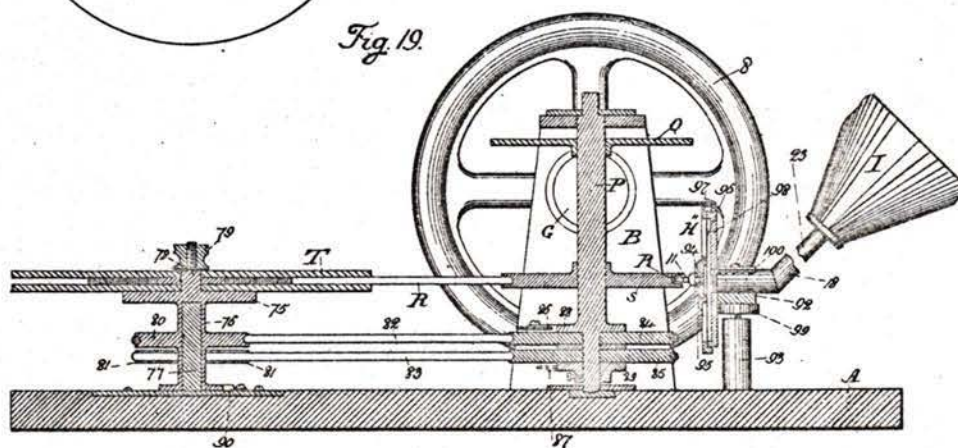
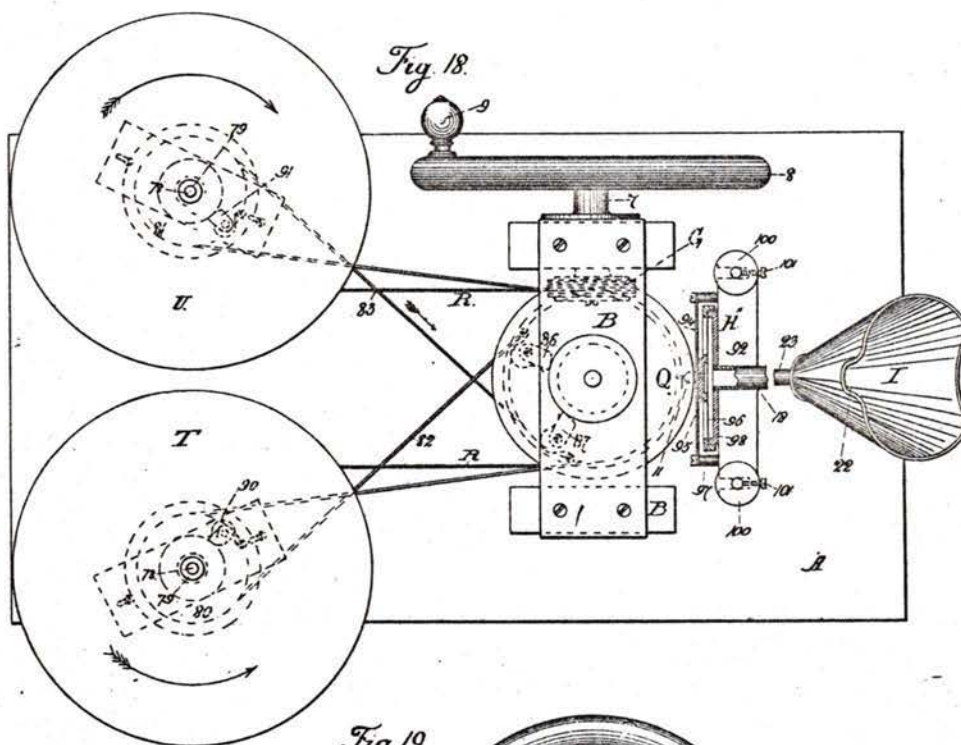
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C. A. BELL & S. TAINTER.

## RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

No. 341,214.

Patented May 4, 1886.



Witnesses.  
Wm. Kears, Jr.  
C. J. Hendrick

Inventors.  
Cheicester A. Bell  
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By A. H. Bell  
their attorney



# UNITED STATES PATENT OFFICE.

CHICHESTER A. BELL AND SUMNER TANTER, OF WASHINGTON, D. C.

## RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

SPECIFICATION forming part of Letters Patent No. 341,214, dated May 4, 1886.

Application filed June 27, 1885. Serial No. 170,044. (No model.)

*To all whom it may concern:*

Be it known that we, CHICHESTER A. BELL and SUMNER TANTER, both of Washington, in the District of Columbia, have invented a new and useful Improvement in Recording and Reproducing Speech and other Sounds, which improvement is fully set forth in the following specification.

This invention relates to the formation, in a solid substance, of elevations and depressions, or other inequalities corresponding more or less perfectly to the forms of sound-vibrations, and the reproduction, by means of such inequalities, of the sounds represented by them.

The invention consists, first, in the formation of the record or "phonogram," as it has been called, by means of a cutting-style which is vibrated by the sound-waves or sonorous vibrations to be recorded. The vibrations may be impressed upon the style directly by the impact of the sound-waves upon some device mechanically connected with or carried by the cutting-style or its support, or indirectly through the action of an electric current or other suitable

vibratory medium. Heretofore a large number of contrivances have been devised for converting electrical impulses into mechanical vibrations, and they could, of course, be used for vibrating the cutting-style. Otherwise they have no relation to this part of the present invention, the essential new feature of which is the removal of material to form the record by a cutting, gouging, or graving action of the vibrating style. Heretofore the vibrating style has, as in Edison's well-known phonograph, simply indented the recording material.

It has been proposed to cut the record in the edge of a strip of metal or other solid material by vibrating the strip in contact with the cutting-edge of a rotary disk-cutter; but this proposal is essentially different from this invention, the new mode being applicable to cutting the record upon all sorts of surfaces, and not upon strips only, and is, besides, believed to be later in time than this invention. Under this part of the invention are included the vibratory cutting-style as a new device in a sound-recorder, and the combination of the same with other devices: also the cut or engraved record itself. In this new or improved form of record not only may a larger number of words or sounds be recorded in a given surface than has

been practicable with the indented records heretofore in use, but the recorded vibrations are also sharper and better defined. It is found that an indenting style smooths over the crests of the larger elevations, and also rubs out some of the finer ones.

The invention consists, secondly, in engraving or cutting the record in a waxy or amorphous and slightly cohesive substance. Preferably, a compound of beeswax and paraffine (the latter in excess) is employed. This compound has no tendency to clog the style, but is readily removed thereby in chips or shavings. This part of the invention also consists in a recording material composed of a wax or waxy surface on a paper or pasteboard foundation. Heretofore it has been proposed to use soft paper saturated or coated with paraffine as the material for recording by the indenting method; but its use does not appear to have been successful, and an outer layer of tin-foil was therefore employed to receive the indentations.

The invention consists, thirdly, in cutting or engraving the record in the form of a groove with sloping walls, the sound-waves being represented by elevations and depressions at the bottom of the groove or otherwise. The advantage of this form of record is that it forms an efficient guide to the reproducing-style.

The invention consists, fourthly, in loosely mounting the reproducing-style so that it can readily be guided by the record. Preferably the reproducing-style, or rather what may be called the "head" of the reproducing-instrument, is mounted on a universal joint, and the style is pressed against the record by the yielding pressure of a spring or weight. Practically in the instruments made by us the pressure is due to the weight of the instrument, modified by the elasticity of a section of soft-rubber tube, which supports the same and constitutes a universal joint; but evidently there are many devices which can be used to mount the reproducer, so that it is free to follow the sound record or phonogram, and which, therefore, would be within the spirit of the invention. The reproducing-style, mounted as just explained, is specially adapted for use in connection with a record in the form of a groove with sloping walls, and this



combination is specially claimed; but it may also be usefully employed in connection with other forms of record.

The invention consists, fifthly, in reproducing directly from the wax record. It is found that such a record has sufficient strength to withstand the rubbing action of the reproducing-style, so that a considerable number of reproductions can be obtained from it. The smoothness of the wax gives it a great advantage in this regard. So far as we are aware, no one has reproduced sounds from a wax record by rubbing a style or reproducer over it.

The invention consists, sixthly, in a reproducer or reproducing-instrument in which the reproducing-style, instead of being placed behind its support, projects at the point beyond the edge thereof. One practical advantage of this is that it enables the position of the style on the record or phonogram readily to be observed.

The invention consists, seventhly, in cutting the sound-record in a fusible material, (the waxy compound before referred to, for example,) and then melting the surface slightly, so as to remove any roughness left by the cutting-style. These roughnesses are altogether outside of the sound-vibrations, and give rise in reproducing to scraping noises, which interfere with the intelligibility of the sounds reproduced. These scraping noises are greater with some other modes of reproducing which we have devised, and which will form the subject of other patents, than they are with a rubbing style; but even with the latter the additional smoothness given to the surface by the partial fusion has some advantage.

The invention consists, eighthly, in a sound-recorder having a cutting or graving style which is held by elastic or yielding pressure against the surface on which the record is to be made. The object is to enable the vibratory graver or cutting style to ride over instead of plowing through any elevations on the recording-surface. The depth to which the point of the cutting-style is embedded in the record affects the amplitude of the style's vibration. By this improvement the depth is kept uniform, notwithstanding any slight unevenness of the recording-surface.

The invention consists, ninthly, in having the recorder, of whatever description, or the reproducer, or both, rest against the tablet or recording material by gravity.

The invention consists, tenthly, in combining with a sound-recorder or recording-instrument of any suitable description, and specially with one having a cutting-style, a tube or hollow standard on which the recorder is mounted, and through which the sound-waves are conveyed to the same. This part of the invention also consists in supporting this hollow standard on a hinge, and having a sound-conveying tube communicate with the interior thereof through the hinge. This part of the invention further consists in supporting the reproducer or reproducing-instrument on a

hollow sound-conveying standard the same as explained with respect to the recorder, and in similarly connecting the hollow standard of the reproducer with an exterior sound-conveying tube.

The invention consists, eleventhly, in combining with the recorder a mouth-piece so shaped as to include the nose of the user. It is found desirable to concentrate the sound-waves as much as possible upon the recording instrument or style, and if an ordinary mouth-piece be used the sound reproduced from the record is imperfect in the nasal elements, and sounds somewhat like the speech of a person with a cold in his head. By the use of the improved mouth-piece this disagreeable quality of the reproduced sound is avoided.

The invention consists, twelfthly, in a reproducer in which the sonorous vibrations impressed by the record upon the style are by the latter communicated to a block, plate, or other body of hard rubber, and through said body are transmitted to the air or to other vibratory medium. It is found that this material (hard rubber) gives much purer sounds than metal and other substances heretofore employed. It appears to absorb minute vibrations which give rise to scratching noises, and also to communicate sonorous vibrations without at the same time adding any foreign vibrations due to the movements of its own particles among themselves. The result is probably due to the high elasticity and the homogeneity of hard rubber.

The invention consists, thirteenthly, in combining with the disk of a recording and reproducing apparatus, in which the record is formed on the face of said disk in a volute or spiral by cutting or otherwise by any known or suitable means mechanism for giving to said disk a uniform surface-speed under the recorder. Heretofore when the record was formed on the face of a disk the latter has been given a uniform rotation, so that the same number of words were recorded in the outermost circles as in the smaller inner ones. By giving to the disk a uniform surface-speed under the recorder, or by making the times of each rotation inversely proportional to the distance of the recorder from the center of the disk, the record of any given word or sound will be of the same length at whatever part of the disk it may be, and in this way it is possible considerably to increase the number of words or sounds on a given area.

The invention further comprises certain special instructions, combinations, and arrangement of parts, as hereinafter set forth.

Having now explained the principle of the invention, the manner in which the same is or may be applied will now be explained with reference to the accompanying drawings, which make part of this specification.

Figure 1 is a plan view of an apparatus constructed in accordance with the invention, arranged for recording; Figs. 2 and 3, respectively, a front elevation and cross-section of

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the same; Fig. 4, a view in section and elevation of the recorder; Figs. 5 and 6, views on an enlarged scale of the graver or cutting style; Figs. 7 and 8, views in elevation and section, respectively, of the reproducer; Figs. 9 and 10, similar views of another form of reproducer, and Fig. 11 an elevation of the sound-conveying tube for use with the reproducer. Figs. 12 to 17 represent a modified form of apparatus, Fig. 12 being a back view, partly in section; Fig. 13, a plan, partly in section; Fig. 14, an edge view, partly in section; Figs. 15 and 16, views in elevation and section of the recorder, and Fig. 17 an edge view of a friction-clamp making part of the apparatus. Figs. 18 and 19 are plan and longitudinal sections, respectively, of a form of apparatus also constructed in accordance with the invention, or with parts thereof in which the record is made on a strip, and Fig. 20 a plan, partly in section, of the reproducer for use with such apparatus. Fig. 21 is a view of a recorder in which the style is operated electrically.

Referring to Figs. 1 to 11, A is the base or bed of the apparatus, and B an upright frame, which carries the mechanism for supporting and moving the tablet F, (shown as a disk,) on which the record is to be or has been formed. In the slide C, movable in ways of the frame B, is journaled an arbor, D, on which are fixed a metal disk, E, at one end and a bevel-gear, 1, at the other. The arbor projects beyond the metal disk E, so as to form a support for the recording-tablet F, which is retained thereon by the nut 2 and washer 3. The metal disk E performs the double function of a friction-wheel and of a backing to the recording-tablet F. The bevel-gear 1 engages a similar gear, 4, on the end of the screw 5, which is journaled in a bearing in the slide C, and is tapped through a stationary lug, 6, on the frame B. As the arbor D is revolved, the screw 5 is turned also, and in consequence of its engagement with the lug 6 it moves the slide C lengthwise of the frame B. The rotation is communicated to the arbor from the shaft 7, journaled in bearings of the frame B, and provided at one end with a fly-wheel, 8, and crank-handle 9, and at the other with a friction-pinion, G. This pinion is formed, as shown, of rubber disks clamped together between metal washers. It bears against the back of metal disk E, and communicates motion to it. As the slide C is moved by the action of the screw 5, the metal disk E is carried past the friction-pinion, so that it touches the metal disk in a spiral line, and serves to give a uniform surface speed to each part of the disk as it in turn comes opposite said pinion. The recorder H is placed on the opposite side of the metal disk E, preferably as shown, with the point of the graver or cutting style 11 directly opposite the point where the pinion G touches the disk E. The said pinion thus acts as a support to the disk against the action of the cutting or recording style. The latter is preferably formed of a round

wire by turning the end conical and rounding the extremity, and then grinding off one side to the axis of the wire. This leaves sharp cutting-edges on both sides of the tapering point. These edges remove the material in chips or shavings, like a plane or turning-tool. It is not essential to give this form to the style. Any form which will remove the material and not simply displace it will answer. The style is set in one end of a block, 12, provided on the opposite end with a cup, 13, (see Fig. 4,) and secured in the cross-piece 14 by the nut 15. The cross-piece 14 is fastened to a ring, 16, into which a back plate, 17, is secured. These parts, except the steel style, are preferably of hard rubber, although they could be made of another material—of brass, for example. A sound-conveying tube, 18, is screwed into the back plate, 17, the end being just behind the cup 13. A diaphragm, 105, of any suitable material, whose edges are clamped between the ring 16 and back plate, 17, is placed behind the cup 13, which is pressed against said diaphragm by the elasticity of cross-piece 14. The cup 13 and block 12 serve to communicate the vibrations from the diaphragm to the recording-style.

The tube 18 forms part of a hollow standard, upon which the recorder is mounted. The lower part, 19, of this standard is hinged in the bracket 20, as clearly shown in Fig. 2, so that it can be rocked to bring the recorder into or put it out of action.

On the tube or standard 19 is a ring-weight, Z, which is retained in position by a set-screw, 127. It therefore can be adjusted up or down, in order to increase or diminish the pressure of the style 11 against the tablet F. The use of this weight is desirable, but not necessary.

The tube 21 communicates with the interior of the hollow standard through the hinge, and does not, therefore interfere with its freedom of motion. This tube 21 can be fixed in the bracket or can be allowed to turn, as may be preferred.

The mouth-piece I is shaped to fit the face of the user, and is provided with a notch, 22, to receive the nose. It is attached to the tube 23, which at its lower end fits snugly in the tube 21 and communicates through the series of tubes 23, 21, 19, and 18 with the space inside and back of the cup 13.

In operation the recorder rests by its own weight, assisted by the pressure of weight Z, or by its own weight alone, if preferred, against the recording-tablet F, said weight causing the style to embed itself to the proper extent in the recording material. The sonorous vibrations impressed upon the style are so rapid, as well as so minute, that the record is made as perfectly as if the recorder were held positively, while at the same time the recorder can be moved bodily to conform to the unevenness of the surface of the tablet, and thus keep uniform the depth at which the style operates.

The tablet F consists of a paper or paste-board foundation, 24, with a coating, 25, of



wax. A composition excellently adapted to the purpose, and according to our experience the best, consists of one part, by weight, of white beeswax and two parts of paraffine. The two bodies are melted together, and if not perfectly free from dirt and grit should be filtered. A filtration through cotton-wool will answer. The coating is or may be about one-twentieth of an inch in thickness, (the paper being one-tenth of an inch, more or less,) and can be made by flowing the melted composition over the paper disk or foundation. The surface is preferably turned off flat on a lathe.

In order to place the tablet in the machine, the recorder H is turned back out of the way. When the tablet has been secured in place, the recorder is turned forward into the position shown, the style resting against and slightly penetrating the wax coating. A penetration of one one-hundredth of an inch has been found very effective, the style being formed of No. 16 wire shaped at the cutting end as in Figs. 5 and 6. Upon turning the fly-wheel 8 the disk E and tablet F will be turned, and the style 11 will cut or engrave a spiral line in the wax coating of the tablet. If one talks into the mouth-piece I, the style will be thrown into vibrations corresponding to the spoken words, and the engraved line will be of varying character, the inequalities or variations from uniformity representing the forms of the sound-waves.

The reproducer K, (shown in Figs. 7 and 8,) for reproducing from the engraved tablet or from other suitable record the sounds which formed said records, has a reproducing-style, 26, formed of a narrow metal strip bent near the end, as shown in Fig. 8, and pointed, as shown in Fig. 7. This style is held by cementing, riveting, or otherwise, between the strip 27 and the circular plate 28, both preferably of hard rubber. The strip 27 is fastened at the bottom to an offset on the block 29, in which a passage is formed for the sound-waves. This passage terminates just behind the plate 28. There is a fixed disk, 30, of the same size as the movable plate 28. It is cemented or otherwise fastened on the face of the block, and is perforated at the center, in order not to obstruct the opening therein. The plate 28 is close to but not in contact with the disk. The tube 31, fixed at the upper end to the block 29, is joined at the lower end to the tube 33 by a section of soft flexible vulcanized-rubber tubing, 32. For use the tube 33 is slipped into the tube 19 in the manner shown for the tube 18 of the recorder.

The reproducer K when so placed is mounted upon a hollow standard composed of the tubes or tubing 31, 32, 33, and 19, and in consequence of the flexibility of the rubber tubing 32 it is free to follow the record. No special care is necessary to insure its adjustment, for if the reproducer K be allowed to rest against the record with the style upon the engraved-line the style will of itself gravitate to the bottom of the groove.

There exists always a liability to disarrangement in some part of the machine either in the recorder or the support therefor or the recording-tablet or its support, or if there be no disarrangement it would be difficult to insure that the reproducing-style should touch the record precisely at the proper point if the reproducer be held rigidly. Difficulties on these accounts are avoided by the loose or flexible mounting of the reproducer, the style automatically adjusting itself to the proper place on the record. It will be seen that the reproducer is mounted on a universal joint, so that it can move in any direction. The movement parallel with the face of the tablet would, however, by itself allow the style to follow and adjust itself to the record to a useful extent.

In operation the reproducer K is placed against the record, and on turning the wheel 8 in the same direction and at about the same speed that it was turned in recording, the record will move the style 26 and plate 28, so as to throw the air in the hollow standard into vibrations, and produce sound-waves similar to those which originally acted upon the recording-style to make the record. The reproduced sounds are audible by placing the ear in proximity to the mouth-piece I; but it is preferred to withdraw said mouth-piece, and to connect the flexible tube 34 (see Fig. 11) with the tube 21 and listen at the ear-piece 35. After the record has been cut it will of course be understood that the machine is turned back to the starting-point for reproducing. The surface of the cut record can be rendered more smooth by removing the engraved tablet from the machine and exposing the surface to heat—as, for example, by rotating the tablet face downward over an alcohol-lamp until the surface begins to glisten. Of course a too long exposure would destroy the record. It is the merest surface action that is required. The record can be used for reproducing without submitting it to this operation and without removing it from the machine. It may, however, be removed, and at any time thereafter replaced on the same or a similar machine, and be made to reproduce the original sounds.

The reproducer K' (shown in Figs. 9 and 10) has the style 26 attached to the outer of two light plates, 36 and 37, which are attached to a diaphragm, 38, of thin sheet rubber clamped at the edges between the ring 39 and the border of the back plate, 40. The tube 31 is fastened in the back plate.

It will be observed that in both forms of reproducer the style 36 projects beyond the edge or end of the instrument, so that the position of its point on the record can be easily seen.

Referring now to Figs. 12 to 17, A is the bed, B an upright frame, D an arbor, E a metal disk, F the tablet, and G a friction-pinion, as in Figs. 1 to 11. The nut 2 and washer 3, the shaft 7, wheel 8, and crank 9, and the paper disk 24 and wax coating 25 are identical with the parts similarly numbered in Figs. 1,



2, and 3. The arbor D, instead of being journaled in a slide, is carried by an arm, L, which is supported by and is fixed on the short shaft 50. This shaft is supported on centers 51 and 52, so that the arm L can be rocked. The worm-wheel 53, loosely mounted on the shaft 50, is held stationary by the clamp M, the jaws 54 fitting on either side of the wheel, and being pressed against it by the thumb-screw 55. The arbor D carries a screw-wheel, 56, which engages the worm-pinion 57 at the upper end of shaft 58. The screw 59 at the lower end of the shaft engages the worm-wheel 53. This shaft 58 and the gears 57 and 59 carried thereby prevent the arm L being turned independently of the worm-wheel 53, except as the said shaft is rotated. As the arbor D, disk E, and tablet F are rotated, the screw 56 turns the shaft 58, and consequently—the worm-wheel 53 being held stationary by the clamp M—the arm L is swung gradually to one side, so that the recorder engraves a spiral line on the wax face of the tablet. When the record has been cut, it is only necessary, in order to restore the tablet to the starting-point for reproducing, to draw back the recorder and to loosen clamp M, when arm L can be moved at once to the proper position.

A recorder constructed and mounted precisely as in Figs. 1, 2, 3, and 4 could be used in this machine; but, as shown, the recording-instrument H' is modified to some extent. The cutting-style 11 (which is the same as that of Figs. 4 to 6) is set into a block, 60, carried by a metal strip, 61. This is fastened to a block, 62, at the lower end of a back piece, 63, which is attached to the upper end of the tube 64, which forms the hollow standard for the recorder, and which is mounted on the bracket 65, so as to be capable of being turned to put the record into or out of action. The sound-conveying tube 66 corresponding to tube 21 of Figs. 1 and 2 communicates through the hinge with the interior of the tube 64. In front of the opening at the upper end of tube 64 is stretched a diaphragm, 67, of thin sheet metal, or it may be of other membrane or material, its edges being clamped between the ring 68 and back piece, 63, soft-rubber rings 69 and 70 being interposed one on each side of the diaphragm. On the opposite side of the diaphragm 67 from the tube 64 a light plate, 71, of metal cupped in the center, is held against the diaphragm by the pressure of the strip 61, a projection on the back of said strip bearing against the said plate 71.

In this machine the reproducer K, instead of being mounted on the same bracket as the recorder when the latter has been removed, is carried by a separate bracket, 72, the tube 33 being hinged thereto, so that the recorder and reproducer remain, or may remain, always attached to the machine, it only being necessary to turn one or the other into position, as may be required.

Referring to Figs. 18 to 20, A is the base or

bed, B an upright frame, 7 the driving-shaft, 8 the fly-wheel, 9 the operating-crank handle, and G the friction-pinion, as in Figs. 1 and 2. The arbor P is supported in an upright position in bearings of the frame A B, and is revolved by the friction-pinion G engaging the friction-disk Q. The record is made on a wax-coated strip, R, of paper, which is passed around the periphery of the disk S in the groove formed thereon. As the strip passes in front of the recorder or reproducer, it is wound off one reel—say the reel T—and upon the other reel, U. The strip can be wound back upon the reel T when desired. Each reel rests by its own weight upon a platform or flange, 75, at the upper end of a hollow shaft, 76, which turns upon a stud, 77, fastened at the base to the bed B. A pin, 78, passes through the center of the reel, and forms a journal for it to turn upon. A nut, 79, holds the reel on, and may be used to bind it with more or less tension. On each shaft 76 is a belt-pulley, 80 and 81, respectively, driven by a crossed belt, 82 or 83, from a pulley, 84 and 85, on the arbor P. These pulleys 84 and 85 are loose upon the arbor, but are provided each with a clutch, 86 and 87, so placed (see Fig. 18) that when the arbor is turned to the left the clutch 87 engages the hub 89 on the arbor, and the pulley 85 is turned therewith, while when turned to the right the clutch 86 engages the hub 88. Each shaft 76 has a stop-clutch, 90 and 91, respectively, which holds it stationary when the strip is being wound on the other reel. Thus, when the arbor P is turned to the left the reel U is revolved in the direction indicated by the arrow, and the sleeve-supporting reel T is held stationary. The strip is thus stretched at all times, the degree of tension depending upon the friction between the reels and their supporting-flanges 75. The recorder H' is carried by a cross-piece, 92, supported by posts 93. The style 11 is carried by a cross-piece, 94, to which it is attached by means of the cup 95, of hard rubber, which forms a nut on the screw-threaded shank of the style, and said cup rests against a mica diaphragm, 96, whose edges are clamped between the screw-ring 97 and the back plate, 98. The tube 18, screwed into the back plate, is fastened by soldering or otherwise to the cross-piece 92. The tube 23 of the mouth-piece I fits into said tube 18. The ends of the cross-piece 92 are slotted to fit around the screws at the top of posts 93 and rest upon nuts 99, and are clamped by nuts 100. By means of these nuts the vertical position of the recorder can be adjusted. After one line has been engraved on the strip, the recorder can be adjusted to engrave as many additional lines parallel thereto as the strip will receive. The slots in the cross-piece 92 allow the recorder to be moved toward and away from the strip, so as to regulate the depth of the engraved line. To insure a greater nicety of adjustment, screws 101 are



tapped through the metal at the closed end of the slots, and bear at the point against the supporting-screws.

The reproducer K', Fig. 20, is similar to that shown in Figs. 9 and 10, except that the style 26 is so placed that the point is at the center instead of projecting beyond the edge of the instrument. Its position on the record is therefore not so readily seen; but with the form of machine shown in these figures this is less important. The same may be said of the loose mounting of the reproducer, although in point of fact the thin rubber diaphragm 38 gives a certain lateral play to the style. The tube 31 is rigidly fastened to a cross-piece, 102, identical with the cross-piece 92, and with said tube 31 the bearing-tube 30 and ear-piece 35 are connected.

The paper strip can be easily coated with the beeswax and paraffine compound by running the same through a body of melted composition and scraping one side, leaving what adheres to the other to harden thereon.

In Fig. 21 an arrangement for operating the recorder by electro-magnetism is shown. The magnet 107 is mounted on a bar, 108, journaled in bearings in standards 109. It is provided with a bobbin, 106, of wire, surrounding the pole-piece, which bobbin is included in a circuit over which electrical undulations are caused to pass by any suitable transmitting-instrument—for example, such as commonly employed on telephone-lines. In front of the pole-piece or core of the bobbin is a diaphragm, 105, of magnetic material, whose edges are clamped between the ring 16 and back plate 17. The cup 13 should always be in contact with diaphragm 105, and is pressed against it by the spring of piece 14. This cup, as well as the style 11, block 12, nut 15, and cross-piece 14, is the same as in the recorder H of Figs. 1 and 4.

It is evident that various modifications other than those indicated can be made and the invention still be employed in whole or in part, and also that parts of the invention may be used separately.

In the foregoing description details have been given with some minuteness. This has been done to furnish the best information in our power for enabling those skilled in the art to make and use the invention, and not with the intention of limiting the invention to the precise dimensions, proportions, shapes, and materials stated.

A means has been shown for impressing vibrations upon the recording-style by an electrical current through the intermediary of an electro-magnet, in a manner similar to that in which the diaphragm of an ordinary receiving-telephone has been vibrated.

It is evident that other means heretofore used for vibrating a diaphragm could be used in place of the magnet; also, it is evident that the vibrations of the reproducing-style could be taken up and transmitted by the means heretofore used for taking up and transmit-

ting vibrations, (those of a telephone-diaphragm, for example.)

The term "cutting" is herein employed to indicate an action in which the material is removed in chips, shavings, or other small pieces—as in engraving, turning, and the like—and not simply displaced.

The displacement of the material is not only a different operation from the cutting contemplated by this invention, but is not calculated to accomplish the objects for which cutting or graving is employed.

Having now fully described our said invention and the manner in which the same is or may be carried into effect, what we claim is—

1. The method of forming a record of sounds by impressing sonorous vibrations upon a style, and thereby cutting in a solid body the record corresponding in form to the sound-waves, in contradistinction to the formation of sound-records by indenting a foil with a vibratory style, or cutting a strip by vibrating it against a revolving disk-cutter, substantially as described.

2. The method of forming a sound-record by impressing the sonorous vibrations upon a style in a direction at right angles to the recording-surface, and thereby cutting in a solid body a series of elevations and depressions of varying depth, corresponding in form to the sound-waves, substantially as described.

3. The vibratory cutting-style of a sound-recorder, substantially as described.

4. The cutting-style, in combination with a support permitting the same to be vibrated, and means for impressing sonorous vibrations thereon, substantially as described.

5. A vibratory cutting-style, in combination with a sound-conveying tube for concentrating the sound-waves upon the style, substantially as described.

6. A vibratory cutting-style, in combination with a tablet or other solid body in which the record is to be cut, and mechanism for supporting the same and moving it with reference to the said style, substantially as described.

7. A sound-record consisting of a tablet or other solid body having its surface cut or engraved with narrow lines of irregular or varied form corresponding to sound-waves, substantially as described.

8. A sound-record consisting of a tablet or solid body having its surface cut or engraved with a number of lines of variable cross-section, the irregularities or variations corresponding in form to sound-waves, substantially as described.

9. The method of forming a sound or speech record which consists in engraving or cutting the same in wax or a wax-like composition, substantially as described.

10. The sound or speech record cut or engraved in wax or a wax-like composition, substantially as described.

11. The recording-tablet of a phonograph or sound-recording machine, having as the material for recording sounds or sonorous vibra-



tions the composition of beeswax and paraffine, substantially as described.

12. The sound or speech record cut or engraved in a wax-like composition, such as the compound of beeswax and paraffine, substantially as described.

13. A tablet or body for recording sound-vibrations, consisting of a paper or pasteboard foundation and a surface-coating of beeswax and paraffine compound, substantially as described.

14. The sound or speech record cut or engraved in a wax-like composition, such as the described compound of beeswax and paraffine, constituting a surface-coating to a paper or pasteboard foundation, substantially as described.

15. The method of making a sound or speech record which consists in engraving or cutting in the recording material an irregular groove with sloping walls, the shape of the groove representing the sound-vibrations, substantially as described.

16. The method of making a sound or speech record which consists in cutting in the recording material a groove with sloping walls and of variable cross-section, the variations corresponding in form to sound-waves, substantially as described.

17. The sound-record in the form of an irregular groove with sloping walls cut in solid material, substantially as described.

18. The sound-record cut in wax or wax-like composition in the form of an irregular groove with sloping walls, substantially as described.

19. The combination, with a reproducing-style, of a mounting therefor, which leaves said style-face to move laterally, and thereby adjust itself automatically to a sound-record, substantially as described.

20. The reproducer loosely mounted on a suitable support, so that the reproducing-style is capable of a lateral movement, and may in consequence thereof adjust itself automatically on the record, substantially as described.

21. The reproducer mounted on a universal joint and held against the record by yielding pressure, substantially as described.

22. The combination, with a grooved tablet or other body having a sound-record formed therein, of a reproducer having a rubbing-style loosely mounted, so that it is free to move laterally, and thus adjust itself to the groove, substantially as described.

23. The combination, with the tablet or other body having the sound record formed therein as an irregular groove with sloping walls, of a reproducer having a style for rubbing over said record and mounted on a universal joint, substantially as described.

24. The combination, with a sound record formed in wax or a wax-like material, of a reproducer having a rubbing style for receiving sonorous vibrations from said record, substantially as described.

25. A reproducer having a style projecting

beyond the edge or end of the instrument, so that the position of the point of the style on the record may readily be seen, substantially as described.

26. In a reproducer, the combination, with a vibratory plate or diaphragm, of a reproducing-style fastened flatwise on said plate or diaphragm and bent at the end, substantially as described.

27. The method of recording and reproducing sounds by cutting the record in a wax or wax-like material, and then rubbing over the record the style of a suitable reproducing-instrument, so as to impress sonorous vibrations on said style, substantially as described.

28. The method of improving a sound-record which consists in producing an incipient fusion of the surface, substantially as described.

29. The improvement in preparing a sound-record, consisting in cutting the record in a fusible material, and then producing an incipient fusion of the surface, substantially as described.

30. The sound-recorder having a vibratory cutting-style held against the recording material by yielding pressure, substantially as described.

31. The recording instrument having a vibratory cutting-style and mounted on a hinged arm, substantially as described.

32. The combination, with the tablet or body in which the sound-record is to be made, of the recording-instrument mounted on a hinged arm and resting by gravity against the tablet, substantially as described.

33. The recorder mounted on a hollow arm or standard, which constitutes also a sound-conveyer, substantially as described.

34. The recorder mounted upon an arm or standard hinged to its bracket or base, and provided with a sound-conveyer extending lengthwise of said arm, substantially as described.

35. The recorder mounted upon a hinged arm, and combined with a sound-conveyer which extends lengthwise of the arm, and is connected at the hinge with an exterior sound-conveyer, substantially as described.

36. The reproducer mounted upon a hollow standard which forms a sound-conveyer, substantially as described.

37. The reproducer mounted on a hinged arm, and provided with a sound-conveyer extending lengthwise of said arm, substantially as described.

38. The reproducer mounted on a hinged arm, and provided with a sound-conveyer extending lengthwise of said arm, and connected at the hinge with an exterior sound-conveyer, substantially as described.

39. The combination, with a sound-recorder, of a mouth-piece shaped to surround the mouth and nose of the user, and to concentrate the sound upon the recording devices, substantially as described.

40. The combination, with the tablet, in the



form of a disk, and a recorder or reproducer, of mechanism for causing a spiral line to be traced on the disk by the recorder or reproducer at a uniform surface-speed, substantially as described.

41. The combination, with the tablet, in the form of a disk, the arbor, and the metal disk operating as a friction-wheel, of the slide, or its equivalent, such as herein shown, in which said arbor is journaled, and the friction-pinion for revolving said disk; substantially as described.

42. The combination, with the recorder or the reproducer, the disk, the arbor, and the laterally-movable support to the arbor, of the friction-pinion placed behind and bearing against the disk at a point opposite the recorder or reproducer, substantially as described.

43. The combination, with a recording-style and the support therefor, of a cup on the back of said support, and the sound-conveying tube terminating just behind the cup, substantially as described.

44. In combination with the style of a sound-reproducer, a vibratory body or plate of hard rubber, upon which vibrations are impressed by said style, and through which they are transmitted, substantially as described.

45. A tablet provided with a wax or wax-like coating, and having engraved in said coating a spiral line with inequalities or irregularities corresponding in form to sound-waves, substantially as described.

46. A tablet provided with a coating of wax or wax-like composition, and having a sound-record engraved in said coating, said engraved coating having the glazed surface which results from an incipient fusion of the wax after cutting or engraving the record, substantially as described.

47. In combination with a sound-recorder, a flaring mouth-piece shaped to fit over the face of the user and to include his nose, and communicating through a tube or contracted opening with the space behind the diaphragm of said recorder, substantially as described.

In testimony whereof we have signed this specification in presence of two subscribing witnesses.

CHICHESTER A. BELL.  
SUMNER TANTER.

Witnesses:

PHILIP MAURO,  
C. J. HEDRICK.



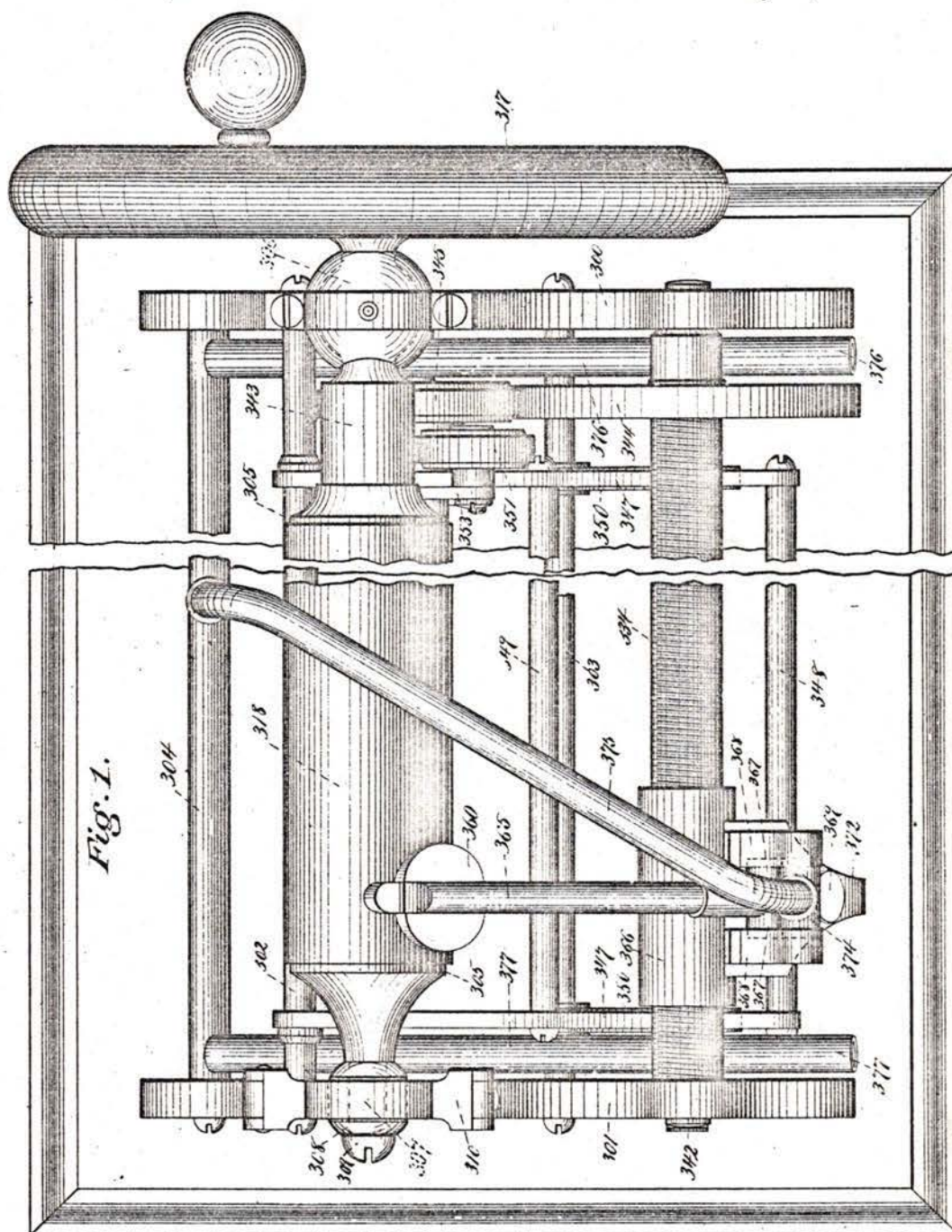


S. TAITER.

APPARATUS FOR RECORDING AND REPRODUCING SOUNDS.

No. 341,288.

Patented May 4, 1886.



Witnesses  
*W. A. Schenck*  
*Philip H. Hays*

Inventor  
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*his attorney.*





(No Model.)

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S. TAINTER.

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Fig. 17.

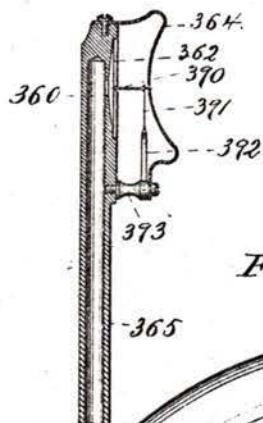


Fig. 8.

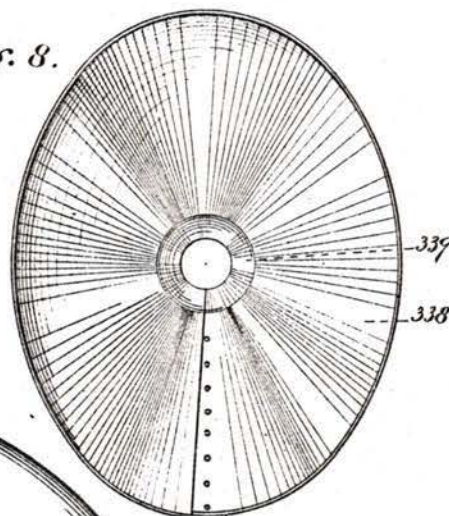
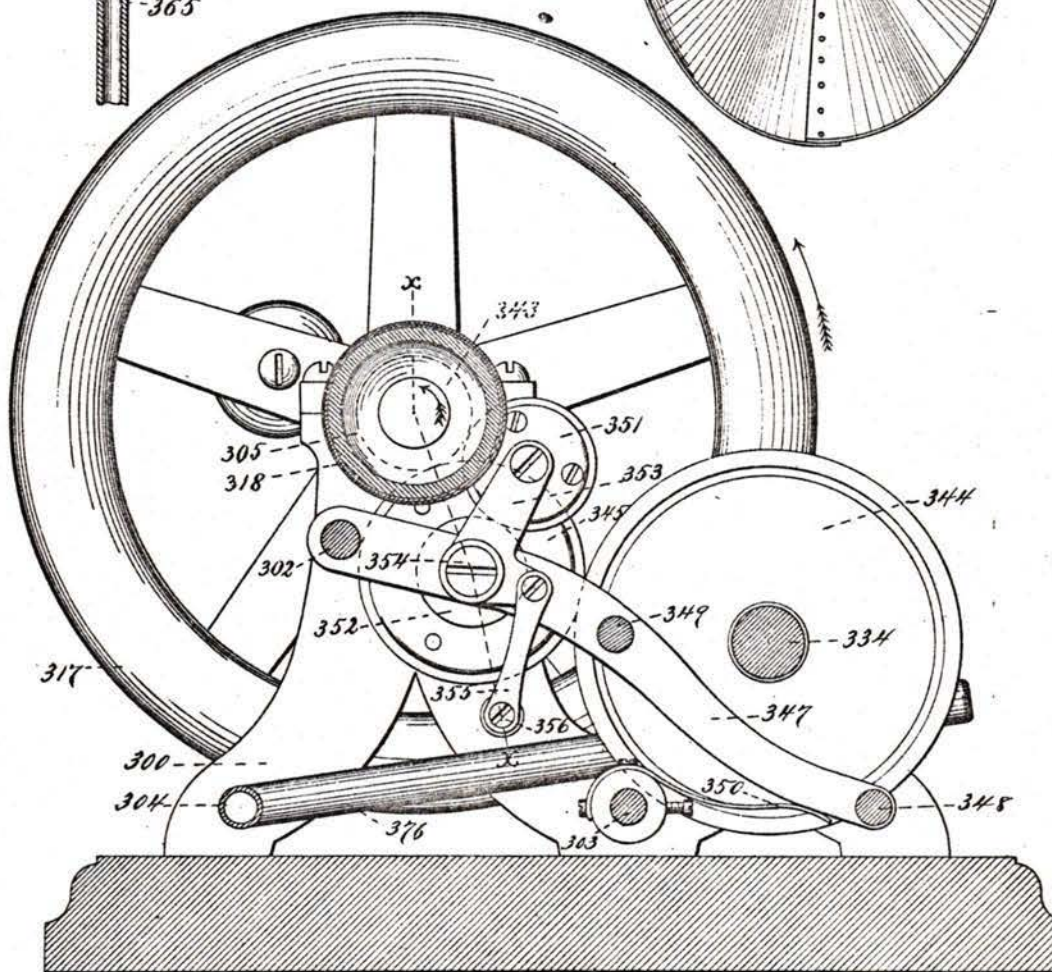


Fig. 2.



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 his attorney





(No Model.)

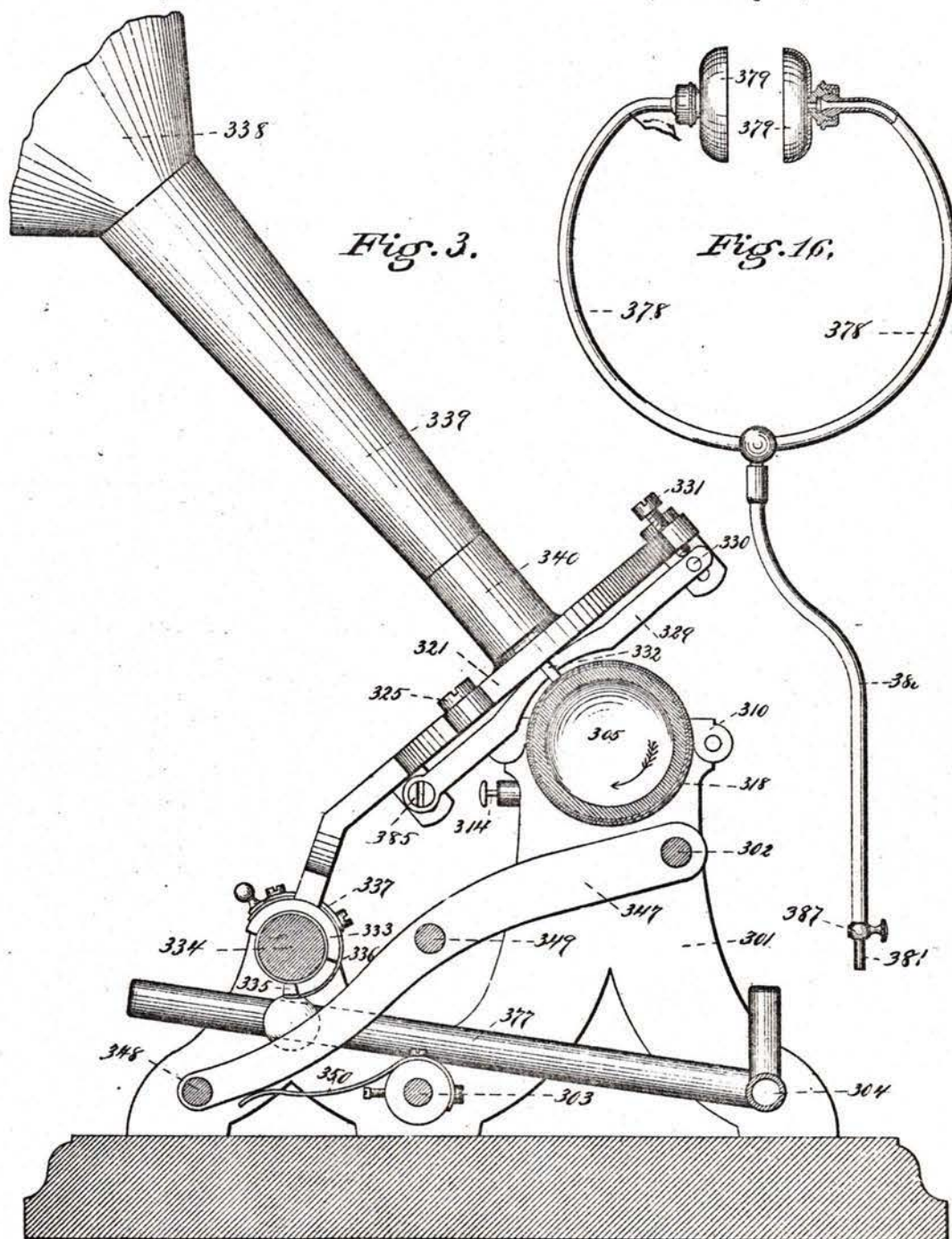
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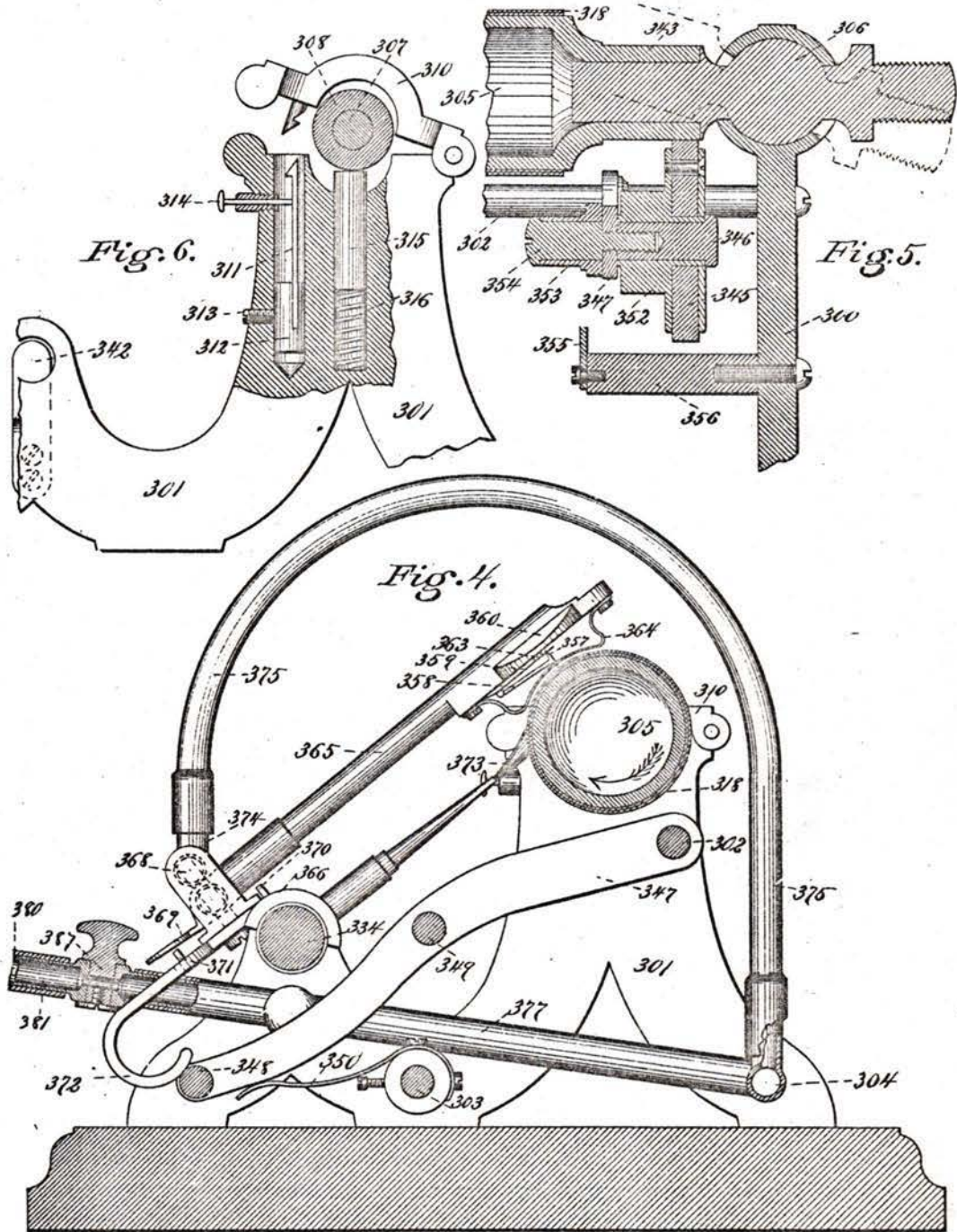


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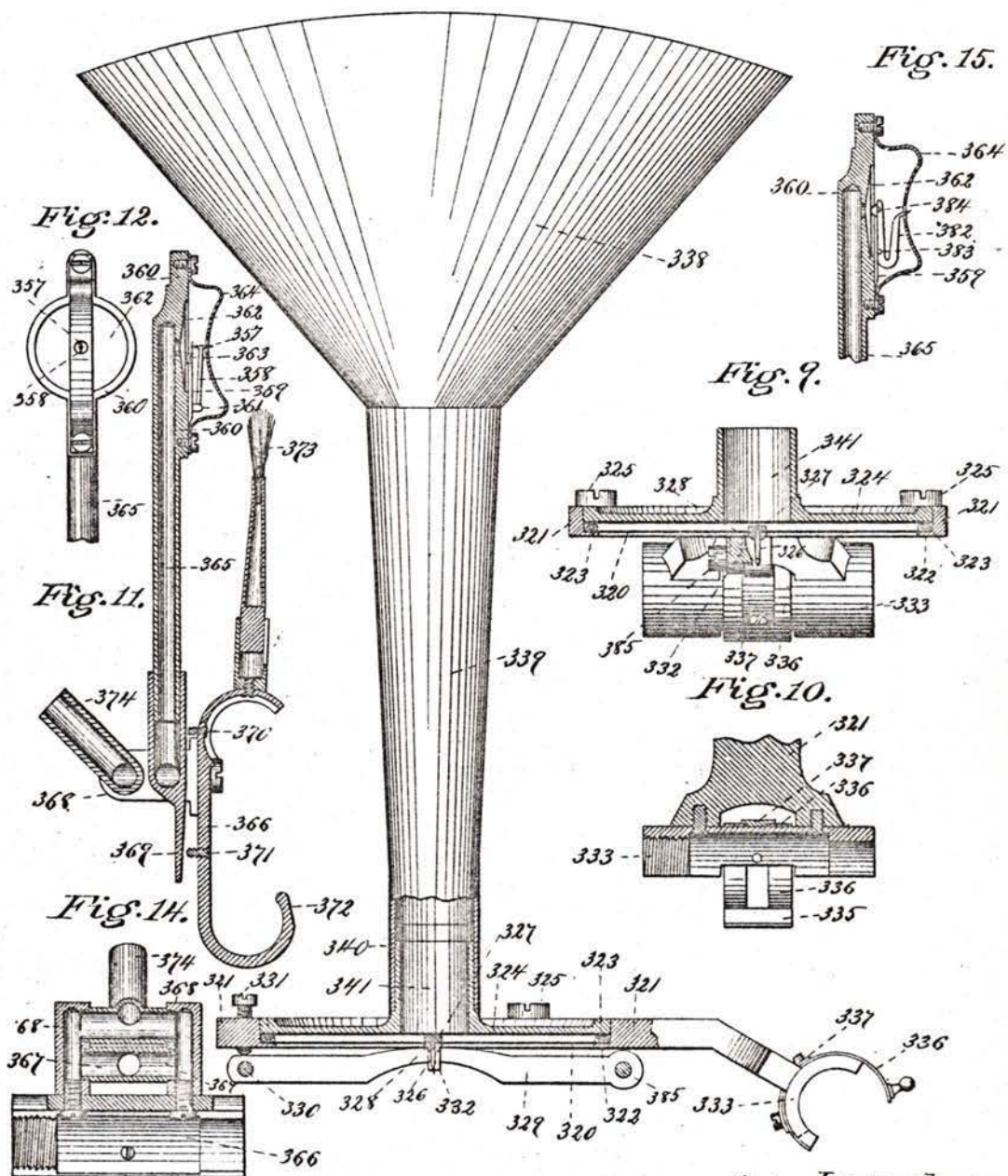
S. TAINTER.

# APPARATUS FOR RECORDING AND REPRODUCING SOUNDS.

No. 341,288.

Patented May 4, 1886.

Fig. 7.



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Fig. 13.

357  
358  
359  
361

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his attorney.



# UNITED STATES PATENT OFFICE.

SUMNER TAINTER, OF WASHINGTON DISTRICT OF COLUMBIA.

## APPARATUS FOR RECORDING AND REPRODUCING SOUNDS.

SPECIFICATION forming part of Letters Patent No. 341,288, dated May 4, 1886.

Application filed December 4, 1885. Serial No. 184,655. (No model.)

*To all whom it may concern:*

Be it known that I, SUMNER TAINTER, a resident of Washington, in the District of Columbia, have invented a new and useful Improvement in Apparatus for Recording and Reproducing Sounds or Sonorous Vibrations, which improvement is fully set forth in the following specification.

This invention has for its object to increase the general efficiency of apparatus for recording and reproducing speech and other sounds, commonly known as "phonographs;" and it consists, principally, in the following improvements:

First. A new recording-tablet is employed. It consists of a hollow cylinder or tube of paper, or other suitable material, coated with wax or wax-like composition, preferably a compound or mixture of beeswax and paraffine. The record is cut in the coating. The advantages of this form of tablet are that it may be very light while having sufficient stiffness to retain its form and avoid the danger of cracking the coating, that it is compact and adapted for transmission through the mails or otherwise, that the recording-surface is continuous, and that it can very readily be placed on and removed from the holder by which it is supported and rotated in recording and reproducing.

Second. The tablet-holder is made in the form of a cylinder, over which the tubular tablet can be forced or slipped and from which it can be removed as desired. This cylinder may be solid; but for lightness it is preferably made hollow. It is of metal, or may be of other solid material. It is journaled in bearings, and is provided with a crank or other means for rotating the same.

Third. In order to support the tablet-holder in the most solid manner, it is provided with a journal at each end, and the journals and bearings are constructed to prevent end motion. It is made detachable from its support at one or both ends, in order to permit the placing and removal of the tablet. It will be understood that any ordinary or suitable means may be used for this purpose; but it is preferred to use the means next to be described.

Fourth. To facilitate the placing of the tablet on the holder and its removal therefrom,

and to avoid the removal of the tablet-holder from the machine-frame when this operation is performed, a ball-journal fitting in a cup or socket bearing is employed at one end, (the other end being made detachable from the machine-frame,) so that the holder can readily be tipped up and held in that position while placing or removing the tablet. The ball-journal and socket-bearing prevent end motion of the tablet-holder.

Fifth. With the object of further facilitating the placing and removal of the tablet, the detachable end of the tablet-holder is held down by means of a catch or other device which can readily be released, and a spring is combined with the holder in such a way as to raise the detachable end thereof when the catch is released.

Sixth. The journal at the detachable end of the tablet-holder, instead of resting directly upon the machine-frame, or a bearing attached thereto, is provided with a box or sleeve which fits over the journal and forms the bearing therefor. This box or sleeve remains on the journal when it is detached, and protects it from dirt, as well as prevents the lubricant on the journal from soiling the hands of the person using the machine. The spring for raising the holder acts upon this box, (a rod being interposed,) and the journal is relieved of its pressure. Another advantage which the use of this box or sleeve gives is that if the two bearings in the machine-frame are not precisely in line the box or sleeve may adjust itself properly without jamming the journal. The very slight space which always intervenes when two separate pieces rest in contact will suffice to compensate for the very slight irregularity in alignment which a careful workman would leave.

Seventh. For recording the sonorous vibrations in or on the tablet, and for producing the sounds from the record, the recording or the reproducing instrument (called herein after "recorder" and "reproducer," respectively,) is moved lengthwise of the tablet by a screw, which is revolved at a less speed than the tablet. Thus with a comparatively coarse-threaded screw the lines may be traced on the tablet very close together. Heretofore the lines were the same distance apart as the threads of the screw.



Eighth. To enable the recorder and reproducer readily to be applied to and removed from the screw, so that one screw can be used for both instruments, they are each provided with a divided or partial nut, which engages the screw. To prevent the instrument from being disengaged accidentally, a guard is or may be provided which can be slipped under the screw when the instrument is in place, or be withdrawn when it is desired to remove it. Both the reproducer and the recorder may have such a guard; but practically it is more important for the recorder.

Ninth. Instead of having the recorder and reproducer mounted upon a slide moving in ways or guides, and connected with a screw for moving the same, they are mounted on a carrier, which is not only engaged by said screw, but supported by the same, so as to be movable lengthwise of the screw, and capable also of turning on it as on a journal. Thus devices heretofore considered necessary are dispensed with and a movement of the recorder or reproducer toward and away from the tablet is provided for.

Tenth. It is often desirable, especially in reproducing, to stop the operation of the machine temporarily. To enable this to be effected instantly without stopping the main shaft of the machine, mechanism is provided for putting the feed-screw out of action, and at the same time automatically lifting the instrument clear of the record. Heretofore it has been necessary to stop the machine entirely. This is not desirable, because in stopping and restarting the machine a difference in speed, which appears on the record or in the sounds reproduced, is almost certainly made, particularly where a fly-wheel is used to give steadiness of motion.

Eleventh. It is also desirable in reproducing to be able to repeat a word, a sentence, or paragraph. To effect this a reversing as well as a stop mechanism is employed, so that by bringing said mechanism into action the motion of the reproducer is reversed and the instrument is brought back to the beginning of the part to be repeated, being meanwhile lifted clear of the record, which continues or may continue to revolve in the same direction at a uniform speed.

Twelfth. In order that the depth of the record may be unaffected by the slight distortions of the recording-surface, (which it is very difficult to avoid, whether this surface be plane, as in the disk-tablet, or cylindrical, as in the improved form of tablet before indicated,) the recorder is pressed toward the recording-tablet by yielding pressure, (such as that of gravity or a spring,) and is provided with a rest, which bears upon the tablet. The recording-style projects beyond this rest and is connected with a diaphragm or other known or suitable means for impressing sonorous vibrations upon it independently of the rest. By having the recorder maintained always at a given distance from the recording-surface

independently of the recording-style, it is possible to cut effectively a shallower record than can be done otherwise, because if the recorder is held stationary the depth of the record must always be greater than the variations in the distance of the recording-surface due to the distortions thereof, and, on the other hand, if the yielding pressure of the recorder is borne by the style it will, if heavy enough for other purposes, press the style to a greater depth than is otherwise necessary. The use of the rest thus relieves the recording-style of pressure, and enables it to be mounted more sensitively and to be made lighter, while at the same time and for a like reason its amplitude of vibration under a given impulse and consequently the strength of the record are increased. The rest could, of course, be used with any ordinary or suitable mode of mounting the style.

Thirteenth. To regulate the depth of the record the rest is made adjustable lengthwise of the recording-style.

Fourteenth. In order to secure the most sensitive mounting for the recording-style, the latter is made from a short piece of wire and is attached directly to a diaphragm, so as to be carried thereby, the means preferably employed being a screw-thread on the style, a nut of hard rubber engaging the same, and a disk or washer of hard rubber, between which and the nut the diaphragm is clamped.

Fifteenth. A sound conveyer or concentrator is used for the recorder, which concentrator comprises a flaring mouth-piece of elliptical or oval section and a tapering tube forming a continuation thereof. It is found that a mouth-piece which concentrates the sound is desirable to increase the strength of the record, that a mouth-piece which covers the nose is desirable to convey the nasal as well as other vibrations, and that a tapering tube is desirable to amplify and re-enforce the sound-waves. It is found that the longer this tube is, within certain limits, the greater its re-enforcement of the sound; but that a too great length gives a hollow effect, as when words are spoken into an empty barrel. For the sake of lightness it is preferred to make the mouth-piece and tube of thin sheets of hard rubber, or of paper, or the like material. Metal mouth-pieces and tubes have also been used with good effect.

Sixteenth. Where the record is cut in wax the little shavings or chips are apt to cling to the record and have to be brushed off before reproducing. This can be done by hand; but it is not desirable to rely wholly upon hand-brushing, as too much care would have to be exercised to insure that no particles adhere. The record is also liable to collect dust. To avoid difficulty on these accounts without care on the part of the user, the reproducer is provided with a small brush, which bears upon the tablet and sweeps the record in advance of the reproducing-style.

Seventeenth. The record is not always per-



fectly true or straight—that is to say; the recording-style not only moves lengthwise or at right angles to the recording-surface, but has or is liable to have a side vibration, which of course is recorded in the tablet. These side vibrations produce errors in reproducing unless means are provided for enabling the reproducing-style to move sidewise also. The mounting of the reproducer on a universal joint obviates the difficulty to a certain extent, but not altogether satisfactorily, since the inertia due to the large mass of the reproducer is too great for it to respond as quickly as required. The difficulty is in the present invention overcome much more thoroughly by supporting the reproducing-style so that it, or at least the end in contact with the record, can move sidewise independently of the diaphragm or other device upon which it impresses the vibrations. This freedom to move sidewise can be secured by allowing the style to rock upon the end in contact with the diaphragm or other device behind, or by making the style in whole or in part of flexible material, or by mounting it on a flexible support, the flexibility of course being in the required direction.

Eighteenth. In order to allow the reproducing-style the greatest freedom of side movement, while insuring its return to a central position, and without impairing to a serious extent its rigidity in other directions, a comparatively broad and thin strip of spring metal, placed on edge is connected with or forms part of the reproducing-style. Such a strip is very flexible to side pressures, but comparatively rigid to other pressures. The strip is fastened to the diaphragm, or to the device upon which it is desired to impress the vibrations, or it is otherwise hinged so that it can impress vibrations on said device; or said strip may be rigidly connected with the frame of the reproducer and the style be flexibly connected with the outer end of the strip. Preferably the reproducing-style is fastened to the end of a thin metal strip parallel with the width thereof, so as to form a hammer-like arrangement, the style being the hammer-head. It is a pin or wire several times as thick as the metal strip. The vibrations are transmitted through the hammer-head, the metal strip being attached to a spring, or it may be otherwise hinged to the frame of the reproducer.

Nineteenth. In transmitting the vibrations to the diaphragm it is found that with a rigid connection between the record and the diaphragm pronounced foreign vibrations are impressed upon the diaphragm or its substitute, producing scratching noises. These foreign noises can be lessened without diminishing the reproduced speech to the same extent by the interposition of a flat metal spring in such a way that while serving as the means of communicating vibrations to the diaphragm it can be bent independently. It is probable that this spring absorbs the vibrations which

produce the scratching noises to the greatest extent, because they are more minute and rapid than speech-vibrations. Heretofore a section of rubber tubing has been interposed between the style and diaphragm; but it cannot be made as delicate as a metal spring, and for other reasons, also, is not so advantageous. For example, it is believed that it does not transmit the true vibrations of the record with as much clearness, the rubber loses its elasticity after a short time, and the tubular form of spring is less compact and less easily secured in place.

Twentieth. Another difficulty in reproducing is the passage of the style from one elevation of the record to the next without descending to the bottom of the space between. This causes a rattling sound, and sometimes makes the reproduction unintelligible. It is overcome to a useful extent, if not entirely, by combining with the style a quick-returning spring, by which the style will be pressed to the bottom of the record in the short space between two elevations. This spring should be of quicker return than the diaphragm. It is evident that the same spring may perform this function and also that of absorbing the foreign vibrations.

Twenty-first. The diaphragm is pressed against a concave seat whose walls converge like the walls of a cone, or of a section of a sphere, ellipsoid, paraboloid, or the like toward an opening through which the sound can escape. Thus a space of the general shape of a plano-convex lens, or, taking into consideration the slight convexity of the inner side of the diaphragm of a concavo-convex lens, is formed behind the diaphragm. This form of space is found to convey the sounds better than the flat space, such as customary in speaking-telephone receivers as well as in the ordinary phonograph. This concave seat for the diaphragm is also advantageous, as it makes the latter self-centering. A spring bearing upon the diaphragm holds it in place and also strains it. This spring may or may not be employed for absorbing the foreign vibrations, or for giving a quick return to the style, or for both. The arrangement preferably employed is to have a light flat spring project above the diaphragm, a block (say of cork) being interposed between the spring and the diaphragm and the style pressing against the end of the spring a short distance beyond the block. The block may be secured in the most effective position or it may be left unfastened, so that it can be adjusted lengthwise of the spring to increase or diminish the part projecting beyond the block or to bring it directly under the style. In this last position the loudest reproduction is obtained, but the scratching and rattling noises are also the most pronounced.

Twenty-second. The diaphragm is preferably made of hard rubber, this material having been found to give out purer sounds, the minute foreign vibrations being absorbed to a



greater extent than with mica or metal, either of which and other materials also can be used with intelligible results.

Twenty-third. To protect the style from accidental injury, it is protected by a guard, beyond which only the rubbing end or point of the style projects. As a further protection, the guard is curved outward on either side of the style, forming horns, which, if the reproducer be placed face down on a table, sustain the weight instead of allowing it to come on the style. The particular form of guard is of course only suitable for use with a cylindrical record, which can enter between the horns to make contact with the style.

Twenty-fourth. The sounds from the reproducer can be conveyed to the ear in various ways; but preferably the space behind the diaphragm or other vibratory body is connected by a sound-conveying tube with a double ear-piece somewhat similar to a stethoscope. It consists of two elastic and flexible hollow branches provided each with a cup fastened to the branch by a ball-and-socket joint. The cups fit over the ears and are held against the head by the elasticity of the branches, the universal joint allowing each cup to adjust itself to the head of the user.

Twenty-fifth. It is found desirable in reproducing to modify the loudness of the reproduced sounds according to the sensitiveness of the ear of the listener. This effect can be produced by the adjustment of the block between the spring and the diaphragm mentioned above under the twenty-first head; but it is not always convenient or advantageous to produce it in that way—as, for example, if two persons are listening to the instrument at the same time. To accomplish the desired object, a stop-cock is placed in the sound-conveying tube between the reproducer-diaphragm and the ear, so that by partially closing the same more or less of the sounds can be cut off, as desired. Where more than one person is listening, each of the sound-conveyers may have its own stop-cock.

Twenty-sixth. When a device such as just described is used, or when any device is used which is to be held by the user, or to be placed close to his ear, there is always a liability of the user pulling upon or jarring the reproducer, and if this is not firmly secured of pulling it from the machine. To overcome this difficulty without interfering with the traverse of the reproducer in front of the record, a flexible connection adapted to convey sound, and at the same time not restrict the traverse of the reproducer, is provided between the reproducer and a tube or tubular coupling attached to the machine-frame. The ear-tube or other device is connected with this tube or coupling, so that any pull or thrust comes upon the solid machine-frame, and will or may detach the ear-tube rather than damage the machine.

Twenty-seventh. In placing the reproducer on the screw it is desirable to hold the style

away from the record until the reproducer is in place on the screw, and in removing it to lift the style from the record before attempting to remove the reproducer. The object is to prevent injury to the record. To effect the desired result the standard of the reproducer is hinged to its base or carrier, and is provided with a tail or thumb piece, or some equivalent device, so that in grasping the base or carrier the thumb or other part of the hand pressing upon said tail will hold the reproducer away from the record. Upon release of the tail the reproducer rests by its weight (which is preferably made very small) upon the record.

The invention further comprises certain special constructions, combinations, and arrangements of parts, as hereinafter set forth, among which are included the combination, in one machine, of these several improvements already indicated, or of two or more of them.

Having explained the principle of the invention, a description will now be given of what is considered the best mode of applying the same, reference being had to the accompanying drawings, which form a part of this specification.

Figure 1 is a plan view of a machine or phonograph constructed in accordance with the invention, the reproducer being shown in place and the recorder omitted; Fig. 2, a vertical cross-section in elevation, looking to the right in Fig. 1; Fig. 3, a section in the plane of Fig. 2, but in elevation, looking to the left, the recorder being shown in place and its mouth-piece being broken away; Fig. 4, a view similar to Fig. 3, but with the reproducer in place instead of the recorder; Fig. 5, a partial vertical longitudinal section on line x-x of Fig. 2; Fig. 6, an elevation, partly in section, of a part of the left end of the machine. Fig. 7 is an elevation, partly in section, of the recorder, its carrier, and sound-concentrator; Fig. 8, a top view (on a reduced scale) of the sound-concentrator of the recorder; Fig. 9, a central section of the recorder in a plane at right angles to those of Figs. 3 and 7, showing the base or carrier in elevation, and Fig. 10 a section through the base or carrier of the recorder. Fig. 11 is a central vertical section of the reproducer, its carrier, and certain accessory parts; Fig. 12, a face view of the reproducer; Fig. 13, a perspective detail view; Fig. 14, a section through the base or carrier of the instrument; Fig. 15, a section illustrating a modified form of style; Fig. 16, an elevation, partly in section, (on a reduced scale,) of a listening device with double ear-pieces; and Fig. 17 a section illustrating a third modification of the reproducer.

The frame of the machine, as shown, consists of two upright side pieces, 300 and 301, connected by tie-rods 302 and 303 and the tube 304, which serves as a tie-rod. The tablet-holder 305, in the form of an elongated metal cylinder, is journaled in bearings at the top of the side pieces. The right journal, 306, is ball-



shaped and rests in a socket, (see Fig. 5,) which permits the tablet-holder to be tilted up, as indicated in dotted lines, as well as to be revolved, while endwise motion is effectually prevented. The fly-wheel 317, provided with a crank-handle, is mounted on a prolongation of the journal and serves to revolve the tablet-holder. The left journal, 307, which is or may be cylindrical, fits and revolves within a box, 308, which is held in place on the journal by a screw, 309, in the end thereof. The box 308 is confined between a seat on the side piece, 301, and the hinged cap 310, which is held down by the spring-catch 311, (see Fig. 6,) fastened at the bottom in the plug 312, which is adjustably retained in position by the set-screw 313. The catch can be released at will by a push-pin, 314. Below the journal 307 is a follower, 315, fitting into and movable in a hole in side piece, 301, acted upon by the spiral compression-spring 316, placed below it in the hole. The box 308 rests upon the top of the follower and relieves the journal of all pressure from the spring 316 when the cap 310 is held down by the catch 311. This pressure prevents the box turning. On releasing the catch 311 the spring 316 expands and throws up the journal 307 and the cap 310, as shown in Fig. 6. The cap can then be turned back and the tablet-holder be tipped up and held in an inclined position by a hand on the fly-wheel 317. The tablet consists of an elongated hollow cylinder or tube, 318, of paper or pasteboard—say one-fortieth of an inch in thickness—coated with a layer about one-thirtieth ( $\frac{1}{30}$ ) of an inch in thickness of a compound of one part, by weight, of white beeswax and two parts of paraffine. The beeswax and paraffine should be melted and stirred together, and then filtered, unless they are entirely free from sticks, dirt, and other foreign particles. The coating is or may be applied by stopping the ends of the cylinder, partly immersing it in a bath of the melted composition and turning it therein one or more times, removing it and allowing the material to harden, keeping it in motion meanwhile to prevent running, then immersing and rotating it again, and allowing the adherent layer to harden, and so continuing until a coating of rather more than the thickness above indicated is attained. The surface is then turned smooth in a lathe, being supported on a cylinder like the tablet-holder 305. The tablet is then ready for use by placing over the holder, or it may be kept until wanted. In keeping care should be taken to prevent access of dust. After the tablet has been placed on the holder the detachable end of the latter is pressed down into its bearing, and the cap 310 is engaged by the catch 311, which holds it down.

The record is made on or in the wax coating of the tablet by the instrument shown in Figs. 3 and 7 to 10. The diaphragm 320 (of mica, from six to twelve one-thousandths ( $\frac{1}{1000}$  to  $\frac{1}{1250}$ ) of an inch in thickness) is held

in a frame, 321, between the flange 322 and a ring, 323, of soft rubber tubing, which is held down by the back plate 324, and screws 325, tapped into the frame. The heads of these screws project over the edge of the back plate. The recording-style 326, formed of a steel wire (say, one-thirty-second of an inch in diameter) sharpened at the front or operating end, like an ordinary round-pointed turning tool and screw threaded at the other, is fastened to the center of the diaphragm by the nut 327 and washer 328, which are on opposite sides of the diaphragm, and clamp it between them. The cutting-edge of the style is preferably shaped to cut a groove of curved rather than of V-shaped cross-section. A bar, 329, is hinged at one end to the frame 321 by a pivot screw-pin, 335, and at the other adjustably but rigidly fastened thereto by a screw, 330. A second screw, 331, bearing at the point against the top of the bar 329, assists in securing an exact adjustment and in holding the bar rigid. At the middle of the bar is an enlargement, 332, which extends into close proximity to the recording-style (see Fig. 9) and whose bottom is polished or made smooth, so that it may bear upon the wax-coated tablet and move over it without injury to the wax surface. The frame 321 is provided with a base or carrier, 333, in the form of a half-nut. In use this nut is supported and engaged by the rotatory feed-screw 334, which is journaled in bearings in the side pieces, 300 and 301. The base or carrier is elongated to give a sufficient bearing on the screw to prevent the tipping of the recorder sideways. To assist in preventing this, and also to prevent the carrier being lifted from the screw, a guard is provided, which consists of a block, 335, attached to the end of a curved slide, 336. This slide is guided by the piece 337, and can be turned from the position shown in Fig. 7 when the guard does not interfere with the placing of the carrier on the screw into the position shown in Figs. 3 and 10, when it prevents the removal. The carrier is, however, free to turn on the screw, as on an axle, so that the recorder, under the action of gravity, will press against the tablet, the bar 329 forming a rest to support it. The recording-style projects beyond the rest and enters the wax coating, penetrating it a distance which is regulated by the adjustment of said rest or bar 329. The sound-conveyer consists of an elliptical mouth-piece, 338, and a tapering tube, 339, both made, for lightness, of hard rubber, in thin sheets—say one-thirty-second ( $\frac{1}{32}$ ) of an inch thick. A metal thimble, 340, is attached to the small end of the tapering tube, which fits over a tubular projection, 341, on the back plate. The rotation of the feed-screw 334 moves the recorder lengthwise of the recording-tablet, and this movement, in connection with the rotation of the tablet, causes the style to trace a spiral line in the wax, which line becomes a sound-record by talking into the mouth-piece 338, and thereby impressing sonorous vibra-



tions upon the diaphragm and style. The style then cuts a variable line, whose irregularities or inequalities correspond to the sound to be recorded. The spiral line can be omitted for a given distance, when desired, by simply lifting the recorder from the tablet. The feed-screw 334 should be so mounted as to prevent endwise movement, which would tend to make the traced line more or less zigzag. As shown, a spring, 342, (see Figs. 1 and 6,) presses constantly upon the left end of the screw to keep it against the bearing at the opposite end. The feed-screw is revolved by the friction-wheels. (Shown in Figs. 1, 2, and 5.) In recording, the friction-pinion 343 on the tablet-holder communicates motion to the large wheel 344, fast on the feed-screw, through the intermediate 345. Thus the feed-screw has a much slower rotation than the tablet-holder, and the convolutions of the line traced on the tablet are much closer together than the threads of the feed-screw. The intermediate 345 is mounted on the stud 346, (see Fig. 5,) which is carried by a hinged frame, so that the intermediate can be moved out of contact with the pinion whenever it is desired to stop the feed, without interrupting the rotation of the tablet-holder. The hinged frame consists of side bars, 347, which are hinged separably on the tie-rod 302; and are rigidly connected with each other by tie-bars 348 and 349. A spring, 350, under each side bar tends to lift the frame and press the intermediate 345 against the pinion 343. The feed-screw is therefore normally in engagement with the tablet-holder; but can be disengaged at will by pressing upon the tie-bar 348. The friction-wheels 351 and 352 are for reversing the revolution of the feed-screw. The wheel or pinion 352 is simply a hub on the side of the intermediate 345. The wheel 351 presses against the pinion 352, and is mounted on a stud at the end of bent lever 353, which turns upon the screw-stud 354 in line with the stud 346. (See Fig. 5.) The lever 353 thus turns about the axis of the wheel 352, and the wheel 351 may roll over the surface of the wheel 352, so as to be pressed against and thus engage the pinion 343 on the tablet-holder. The short arm of the bent lever is connected by a link, 355, with the stud 356, itself secured fast to the side piece, 300. When, therefore, the tie-bar 348 and side bars, 347, are depressed, the lever, as shown in Fig. 2, is turned to the left, and when it is sufficiently depressed the wheel 351 is held against and engaged by the pinion 343. Motion is now communicated through the wheels 343, 351, 352, 345, and 344, the rotation of the feed-screw is reversed, and a more rapid rotation is imparted to it. The carrier will therefore be moved backward (to the left in Fig. 1) more rapidly than it was advanced. There will ordinarily be not much occasion to use the stop and reversing mechanism in recording. It is for use in reproducing that it has been specially devised. The reproducer (see Figs. 1, 4, 11, 12, and 13) has a style, 357,

welded or otherwise fastened to the end of a flexible strip, 358, of thin steel—say three one-thousandths ( $\frac{3}{1000}$ ) of an inch in thickness—so as to project beyond both edges of the same like a hammer-head. The outer end of this style (which should be somewhat more tapering at the point than the recording-style) rubs over the record or tablet. The inner end presses upon a light flat spring, 359, fastened at the lower end to the frame 360 of the reproducer. The strip 358 is soldered into a slit of the ear 361, on the spring, which by bending between the ear 361, and where it is attached to the frame 360 allows the style and strip to be moved in or out, and thus serves to hinge the same to the said frame. The diaphragm 362, of hard rubber about seven one-thousandths ( $\frac{7}{1000}$ ) of an inch in thickness, is pressed against a conical seat in the face of the frame 360 by means of the spring 359, between which and said diaphragm is a little block, 363, of cork. It serves the double function of pressing the diaphragm against its seat, and also of communicating vibrations to it. Cork is used because it is light and conveys vibrations well and has sufficient friction upon the diaphragm and spring to remain in the position in which it may be placed. By leaving it to be held by friction it can be adjusted by the user to give the best effects; but it can be secured by cement or otherwise in the position which the maker or adjuster of the instrument may determine. Preferably it occupies a position intermediate the style 357 and the edge of the diaphragm, as shown; but it can be set directly opposite the style. In the former position there is a certain length of the spring 359 beyond the cork, which length forms a tongue with a very high rate of normal vibration. It absorbs a considerable portion of the small vibrations which produce scratching noises, and it thus makes the articulation more distinct. It also reduces somewhat the loudness of the sounds reproduced, but the increased distinctness more than compensates for any loss in loudness.

Another effect which the tongue has is to return the style more perfectly when it has been pushed out by an elevation on the record. It does this because its normal vibration is quicker than that of the diaphragm or because its amplitude of vibration is larger, or for both reasons. It will be understood that this spring-tongue is compressed by the weight of the reproducer, which is sustained by the style. This weight is actually very small, the frame being made, for lightness, of hard rubber, but in comparison with the strength of the spring-tongue it is considerable. It will be observed that the diaphragm is strained by the spring in addition to the strain due to the weight of the reproducer. The inner end of the style 357 preferably rests in a hole or recess in the spring 359, so that it is prevented from side motion bodily, although capable of rocking on the inner end as a center. The bending of the strip 358 allows this side movement of the



front end of the style to take place with the greatest freedom. A bodily movement of the style sidewise could be permitted, if desired, but a stop should then be used to prevent it from being pushed off the spring 359.

To protect the style and other parts of the reproducer, a guard, 364, is fastened to the front of frame 360, and is perforated at the center for the passage of the style. On either side of the center it is bent outward to form horns to support the instrument when placed face downward on a table or flat surface.

The reproducer, consisting of the parts just described, is mounted upon a hollow standard, 365, which is hinged at the bottom to the carrier 366 by means of hollow trunnions 367, fitting in hollow uprights 368 on said carrier. The reproducer-standard 365 is provided with a thumb-piece, 369, which can be pressed to hold up the reproducer in placing the carrier on and removing it from the feed-screw 334. There are front and back screw-stops, 370 and 371, which limit the movement of the reproducer independently of the carrier. This latter is provided with a half-nut to rest upon and engage the feed-screw, the same as the carrier of the recorder. It is not provided with a guard to retain it on the feed-screw because it is considered unnecessary, particularly when a flexible sound-conveyer is employed, as will presently be described. It is provided with a tail or prolongation, 372, which rests upon the tie-bar 348, (see Fig. 4,) so that when this is depressed to stop or to reverse the feed-screw the carrier will turn to the left (the center of gravity being on that side of the feed-screw) and automatically lift the reproducing-style 357 from contact with the tablet 318, in or on which the record is formed. When the tie-bar 348 is released, the springs 350 raise it and turn the reproducer and its carrier to the right, so that the style again makes contact with the record. It will be observed that the pressure of the springs 350 does not force the style against the record, because the reproducer is hinged to its carrier and only its very light weight comes upon the reproducing-style and the record. On the carrier is a brush, 373, which, when the producer is in action, bears upon the record and clears it of dust or shavings of wax or other lightly-adhering matter in advance of the reproducing-style.

The hollow standard 365 serves to convey sound from the lenticular chamber behind the diaphragm into the uprights 368, with the interior of which the coupling 374 communicates. To this coupling a flexible sound-conveyer, 375, is attached at one end, the other end being connected with an upright branch of the tube 304. Thus the sound is conveyed from the interior of the uprights 368 through the coupling 374 and sound-conveyer 375 and tube 304, the flexibility of said conveyer 375 permitting the traverse of the reproducer, as well as the turning of the carrier 366 on the feed-screw 334. The tube 304 communicates

with tubes 376 and 377, one at each end of the machine. A hearing-tube is or may be attached to either or both tubes. Preferably the apparatus shown in Fig. 16 is employed. It consists of two elastic and flexible hollow branches, 378, each provided at the outer end with a cup, 379, attached by a ball-and-socket joint, and a flexible sound-conveying tube, 380, for connecting both branches with the tube 376 or 377. As shown, there is a hollow metal coupling, 381; at the free end of the flexible tube 380, of such exterior diameter as to fit snugly in the tube which is to receive it. (See Fig. 4.) This coupling is provided with a stop-cock, 387, which can be turned to cut off more or less sound if the reproduction be too loud. This diminution in loudness makes the scratching noises less distracting to a person with a sensitive ear.

In use the cups 379 are placed one over each ear of the listener, the ball-and-socket joint permitting the cup to adjust itself to his head, and the elasticity of the branches 378 drawing them with sufficient pressure to support the apparatus.

The branches may be made of hard vulcanized rubber, in order to secure the requisite flexibility and elasticity; but it is evident that sound-conveying branches having these qualities could be constructed of various materials and in various ways.

Instead of applying the tube 380 to the tube 376 or 377, it may be connected directly with the coupling 374, the sound-conveyer 375 being omitted. This has the advantage of diminishing the length of tube between the reproducer and the ear of the listener, but is open to the objection that the reproducer is liable to be pulled from the machine by incautious movements on the part of the listener.

It may be observed that the reproduced sound may be listened to in various ways, and that it is possible to perceive the sounds by applying the ear close to the reproducer itself.

In the modified form of reproducer shown in Fig. 15 the style 382 is made of a thin plate of sheet-steel—say three one-thousandths of an inch in thickness—of the form clearly shown, fastened on edge on the spring 359, being soldered in a slit in the ear 383, and a similar slit in the end of the metal buttons 384, which end projects through the spring 359. This button bears upon the hard-rubber diaphragm 362, and serves to communicate vibrations from the style to it.

In the form of reproducer shown in Fig. 17 the style 390 is interposed between the diaphragm 362 and the flat spring 391. Near each end the style has a rounded shoulder, and the ends themselves are of smaller diameter, so that they may pass through holes in the diaphragm and spring, as shown, the latter pressing upon the shoulders. The spring 391, whose flat side is toward the diaphragm, is attached to the strip 392, which is soldered or otherwise fastened to the post 393. The spring



291 retains the outer or operating end of the style in place while allowing it freedom to move endwise for impressing vibrations upon the diaphragm. Preferably it exerts a light pressure inward, tending to strain the diaphragm, as well as maintain itself in contact with the shoulder on the style. It supplies the place of spring 359 of Figs. 11 and 15. The strip 392, whose edge is turned toward the diaphragm, allows the operating end of the style to move sidewise. It thus supplies the place of strip 358 of Fig. 11, and that which forms the style 382 of Fig. 15.

The construction of Fig. 17 has the advantage over the other forms that there is less material to be moved by the vibrations of the style.

The parts 391 and 392 can most conveniently be made from a round wire by filing the same flat at proper points.

The operation of the machine has practically been explained in the foregoing description in connection with the several parts of the machine, but an explanation will now be given of the operation as a whole. Having prepared a hollow paper cylinder and coated it with the paraffine and beeswax composition, the coated cylinder 318 (which forms the recording-tablet) is placed upon the tablet-holder 305, which for that purpose is detached at one end by releasing the catch 311, and tipped up, as indicated in dotted lines in Fig. 5. The detached end of the tablet-holder is then returned to its bearings in side piece, 301. Having adjusted the rest 329 of the recorder so that the recording-style 326 projects beyond the enlargement 332 the desired distance—say five one-thousandths ( $\frac{5}{1000}$ ) of an inch—the recorder-carrier 333 is placed on the feed-screw 334, near the left end of the same, the guard-block 335 is turned under the screw, and the recorder is made to rest against the recording-tablet, the weight being supported by the rest 329, and the style 326 penetrating the wax coating. The fly-wheel 317 is then turned, revolving the tablet-holder and tablet, and also, but at a less speed, the feed-screw 334. Since the recorder is moved lengthwise of the tablet as the latter is revolved under it, the recording-style traces, or more specifically cuts, in the wax coating a spiral groove whose convolutions are closer together than the threads of the feed-screw. The convolutions may be eight one-thousandths ( $\frac{8}{1000}$ ) of an inch apart. To make a speech record in or on the tablet, the speaker places the lower part of his face in the mouth-piece 338 and says in a clear and moderately loud voice the words to be recorded, the fly-wheel being kept in motion at a uniform speed of say one hundred and sixty revolutions per minute. If it be desired to mark visibly a paragraph on the record, it can be done by lifting the recorder for a short time from the record, then releasing it, and again speaking into the mouth-piece. The sonorous vibrations which the speaker impresses upon the air in the mouth-

piece 338 and tube 339 are taken up by the diaphragm 320 and style 326, and the latter cuts a groove in the tablet, which is correspondingly irregular. After the record has been cut over the whole tablet, or over as much as may be desired, the recorder is removed. The tablet is also removed and brushed to remove the wax shavings, and then, or at some future time, is replaced on the tablet-holder of the same or of a similar machine. The reproducer-carrier 366 is placed on the feed-screw 334, the tail 372 resting on the tie-bar 348. The thumb-piece 369 of the reproducer-standard is pressed upon to keep the style 357 or 382 from contact with the record until the carrier has been placed on the screw. It is then released, and the reproducer, falling forward, brings the style into contact with the record. Preferably the grooves are so close together that the ridge between them tapers to an edge on top, so that no matter where the reproducer may be placed the style will enter a groove, and being free to move sidewise will, owing to the sloping sides of the groove, penetrate to the bottom thereof under the action of gravity. The fly wheel being turned at about the speed used in recording, the reproducer will follow the spiral groove cut by the recorder, and will be acted upon by the inequalities or irregularities of the record, and made to reproduce sounds or sonorous vibrations similar to those which acted upon the recorder to produce said inequalities or irregularities in the groove. Each elevation as it passes under the style at first presses the latter outward, and, when the top of the elevation is reached, allows it to be returned inward by the tension of the diaphragm and spring, or of the diaphragm alone. By these alternating movements, repeated for each ascent and descent in the record, and corresponding in extent and rapidity with the length and slope of the ascent and descent, the diaphragm is thrown into vibrations corresponding in form to the sonorous vibrations which caused the irregularities or inequalities. In addition to these vibrations, foreign vibrations, due to various causes, are also impressed upon the diaphragm. These should be disregarded, as far as possible, by the listener confining his attention to the speech-vibrations. They will (in the reproducer shown in Figs. 11 and 12) be measurably taken up by the vibration independently of the diaphragm 362 of the tongue formed by the end of the spring 359, which projects beyond the block 363.

In certain speech-sounds it is found that the diaphragm responds too sluggishly, and that in consequence of this sluggishness the style, if influenced by the diaphragm alone, will not descend to the bottom of a depression in the groove, but will skip across, thus cutting off more or less of the vibration. The tongue of the spring 359 responds more readily than the diaphragm and diminishes the danger of false vibrations. This spring-tongue also absorbs a portion of the speech-vibrations, thus dimin-



ishing the loudness of the reproduced sound; but any loss in this respect will be more than balanced by the improvement in distinctness. The vibrations of the diaphragm being impressed upon the air in the chamber behind the same are conveyed through the standard 365, the uprights 368, the coupling 374, the flexible tube 375, the tube 304, the tube 376 or 377, the tube 380, and the branches 378 to the ears of the listener. Should it be desired to interrupt the reproduction for a time, the tie-bar 348 is pressed lightly, thereby withdrawing the intermediate 345 from contact with the pinion 343 and stopping the rotation of the feed-screw 334. At the same time the reproducer-carrier 366 is allowed by the depression of the tie-bar to turn sufficiently to lift the reproducer-style 357 clear of the record, the front stop, 370, coming in contact with the standard 365 and raising the same. Should one or more words, phrases, or sentences not be understood, the tie-bar 348 is pressed more strongly, so as to bring the wheel 351 into engagement with the pinion 343, and thereby reverse the rotation of the feed-screw. When the reproducer has been carried back beyond the part of the record from which the reproduction was not understood, the tie-bar 348 is released, the style again comes into contact with the record, and the reproduction commences at the point to which the reproducer has been brought back. This repetition of what is not understood can be made as often as desired.

Friction-wheels for communicating motion to the feed-screw are preferred to cog or other toothed gearing, (which could of course be used without departing from the invention,) notwithstanding their liability to slip, because they run smoother and are more easily engaged and disengaged. A slip between the wheels causes the reproducer to be fed faster or slower than the spiral on the tablet permits the style to advance. As a general thing, there is more slip in recording than in reproducing, and consequently the reproducer outruns the style slightly. The style should be given enough side play to compensate for this difference in speed; but if not given the only difficulty is that the style will at length slip across the ridge between the grooves, and thus escape the action of a portion of the record, so that it may be necessary to bring back the reproducer by reversing the feed. The loudness of the reproduction is limited as desired by turning the stop-cock 387 to the desired extent.

In the foregoing description of the machine shown in the drawings, dimensions, proportions, materials, and other details of construction are mentioned with particularity for the purpose of enabling others more readily to make and use the new improvements, and not as limitations of the said improvements, since it is obvious that modifications can be made in details without departing from the spirit of the invention, and that parts of the invention can be used separately.

The terms "recorder" and "reproducer" as used herein include simply means (a style, for example) for acting upon a tablet to form a sound-record, or being acted upon by a sound-record, in connection with means whereby sonorous vibrations can be impressed upon the recording-style or its substitute, or can be received from the reproducing-style or its substitute, and such frame or support as may be necessary to an operative device. As hereinafter employed, they mean a recorder or reproducer of any ordinary or suitable description unless a special form is mentioned, or is necessarily implied from the connection in which the recorder or reproducer is used. For example, some forms of recorder and reproducer would not be suitable for use with a wax-coated tablet. In like manner other terms—such as "tablet," "tablet-holder," "carrier," "sound-conveyer," "gearing," &c.—refer to devices of any ordinary or suitable description, except as otherwise indicated.

The present invention is to be considered as an improvement upon or modification of what is shown and described in the application for Letters Patent of C. A. Bell and myself, filed June 27, 1885, and officially numbered 170,644, so far as they relate to common features, and no claim is made herein to any matter described and shown in that application.

Having now fully described my said invention and the manner in which the same is or may be carried into effect, what I claim is—

1. A recording-tablet for a phonograph, consisting of a hollow cylinder provided with a wax or wax-like coating for receiving the sound-record, substantially as described.
2. A recording-tablet consisting of a hollow cylinder of paper provided with a wax or wax-like coating, substantially as described.
3. The recording-tablet consisting of a hollow paper cylinder coated with a composition of beeswax and paraffine, substantially as described.
4. A tubular self-sustaining tablet for recording sounds or sonorous vibrations, substantially as described.
5. In a phonograph and in combination with a sound recorder or reproducer and operating mechanism for causing the said recorder or reproducer to trace a spiral line on the tablet, an elongated cylindrical tablet-holder supported and journaled so that the tubular tablet can be placed on the same, substantially as described.
6. The combination, with a tubular tablet, of the tablet-holder for supporting and rotating the same, substantially as described.
7. A tablet-holder journaled in bearings at both ends and detachable from its support at least at one end, so that a tubular tablet can be slipped over the same, in combination with a sound recorder or reproducer, and operating mechanism for causing the said recorder or reproducer to trace a spiral line on the tablet, substantially as described.



8. A tablet-holder detachably connected with its support at one end and provided at the other end with a ball-and-socket bearing, or bearing which permits the said holder to be tilted for placing a tubular tablet on the same, in combination with a sound recorder or reproducer and operating mechanism for causing said recorder or reproducer to trace a spiral line on the tablet, substantially as described.

9. The combination, with the tablet-holder, the side piece or support at one end of the same, and the cap therefor, of the catch or fastening for said cap and the spring for moving the tablet-holder when the catch is released, substantially as described.

10. The combination, with the tablet-holder and the ball-and-socket bearing or bearing for permitting the holder to be tilted, of the support and cap at the opposite end of said holder, the catch or fastening for said cap, and the spring lifting the journal from said support when the catch or fastening is released, substantially as described.

11. The combination, with the tablet-holder, of the box or sleeve on one journal of the same, the support and cap forming the bearing for said box or sleeve, and the catch or fastening for the cap, substantially as described.

12. The combination, with the tablet-holder, of the box or sleeve held on one journal of the same, the support and cap forming a bearing for said box or sleeve, and the spring whose pressure acts against said box or sleeve, substantially as described.

13. The combination, with the tablet-holder, of the ball-journal and socket-bearing at one end of said holder, the box or sleeve on the journal at the opposite end of said holder, and the bearing for the same, substantially as described.

14. The combination, with the tablet-holder, the sound-recorder, and the feed-screw, of gearing between said holder and feed-screw for revolving the latter at a slower speed than the former, substantially as described.

15. The combination, with the tablet-holder, sound recorder or reproducer, feed-screw, and gearing for revolving the screw, of the carrier for the recorder or reproducer provided with a divided or partial nut for engaging said screw, substantially as described.

16. The combination, with the feed-screw and the carrier for engaging the same, of the movable guard for retaining the carrier in engagement with the screw, substantially as described.

17. The combination, with a feed-screw and a sound recorder or reproducer, of the carrier for the sound recorder or reproducer engaged and also supported by said screw, substantially as described.

18. The combination, with a feed-screw and a sound recorder or reproducer, of the carrier for the recorder or reproducer movable lengthwise of and engaged by said screw and

capable of turning on the same as on a journal, substantially as described.

19. The combination, with a tablet and a tablet-holder, of the feed-screw, a carrier mounted on said screw, and the recorder supported on said carrier and resting against the tablet, substantially as described.

20. The combination, with the tablet-holder, feed-screw, and gearing between the same, of the hinged frame upheld by spring-pressure and the devices connected therewith for putting the feed-screw out of action when the said frame is depressed, substantially as described.

21. The combination, with a tablet-holder, feed-screw, and gearing between the two, of the hinged frame upheld by spring-pressure and reversing mechanism connected with said frame for reversing the rotation of the feed-screw relatively to the rotation of the tablet-holder, substantially as described.

22. The combination, with a tablet-holder, a feed-screw, gearing, and an instrument—the reproducer, for example—engaged by said screw, of stop mechanism for putting the feed-screw out of action and at the same time lifting the instrument clear of the tablet, substantially as described.

23. The combination, with a tablet, a tablet-holder, a feed-screw, gearing, and an instrument—the reproducer, for example—engaged by said screw, of reversing mechanism for reversing the rotation of the feed-screw, the said mechanism being connected with said instrument, so that the latter will be lifted clear of the tablet on the reversal of the feed-screw, substantially as described.

24. The combination, with the tablet and the recorder held against the same by yielding pressure, of a rest bearing on said tablet for supporting the recorder, substantially as described.

25. The combination, with the recorder frame and style and the means whereby sonorous vibrations are impressed upon the style, of the rest attached to said frame and arranged close to said style, the latter projecting beyond the rest to act upon the recording-tablet, substantially as described.

26. The combination, with the recorder, of the adjustable rest attached to said recorder for bearing upon the recording-tablet, substantially as described.

27. The combination, with the recording-style, the recorder-frame, and the means whereby vibrations are impressed upon the style, of the rest attached to said frame and adjustable lengthwise of said style, substantially as described.

28. The combination, with the recorder-frame and the rest attached thereto, of the diaphragm and the recording-style mounted directly on said diaphragm, substantially as described.

29. The combination, with the diaphragm, of the cutting-style formed of a wire sharpened at its outer end and carried by said dia-



phragm so as to vibrate with the same, substantially as described.

30. The combination, with the diaphragm, of the cutting-style provided with a screw-threaded shank, and the nut and washer for securing the same to the diaphragm, substantially as described.

31. The combination, with a recorder having a cutting-style, of the rest for bearing upon the recording-tablet, substantially as described.

32. The combination, with the tablet having a wax or wax-like coating to receive the record, of the recorder pressed toward the tablet by yielding pressure and provided with a cutting-style and the rest for bearing upon the tablet and supporting said pressure, substantially as described.

33. The combination, with the recorder, of the sound-concentrator comprising a flaring mouth-piece and a tapering tube forming a continuation of the same, substantially as described.

34. The combination, with the recorder, of the sound-concentrator comprising a mouth-piece of elliptical form and a tapering tube forming a continuation of the same, substantially as described.

35. The combination, with the reproducer, of the brush for clearing the record in advance of the reproducer, substantially as described.

36. The combination, with the recording-tablet having a wax or wax-like coating in which the record is cut, of the reproducer and the brush for clearing the record in advance of the reproducer, substantially as described.

37. A recording-tablet consisting of a hollow cylinder provided with a wax or wax-like coating and having a sound-record cut in said coating, substantially as described.

38. The combination, with the tablet and tablet-holder, of the feed-screw, the gearing, the reproducer-carrier, and the brush, substantially as described.

39. A reproducer having a flexible or flexibly-mounted style movable sidewise independently of the diaphragm or device to which the style communicates vibration, substantially as described.

40. A reproducer having the style attached to or in one piece with a comparatively broad and thin strip placed on edge, said style in consequence of the flexibility of said strip being movable sidewise independently of the diaphragm or device to which the style communicates vibration, but in consequence of the breadth of said strip being practically rigid to pressures in other directions, substantially as described.

41. The combination, with the reproducer-style and diaphragm or device to which said style is to communicate vibrations, of a comparatively broad and thin strip placed on edge and attached to or in one piece with said style, said strip being hinged to the frame, so that the style may be vibrated in the plane of said strip, substantially as described.

42. In a reproducer, the style attached to a

thin metal strip breadthwise of the same like a hammer-head, substantially as described.

43. The reproducer-style attached to or in one piece with a broad and thin strip, in combination with a diaphragm or device upon which the reproduced sonorous vibrations are to be impressed and a spring carrying said style and strip, and serving as a hinge to permit them to vibrate, substantially as described.

44. The combination, with the reproducer-style and the diaphragm or device upon which the reproduced sonorous vibrations are to be impressed by said style, of a flat metal spring interposed between the style and diaphragm and forming a yielding connection, through which the reproduced vibrations are transmitted, said spring having a practically rigid connection with the diaphragm, substantially as described.

45. The combination, with the reproducer-style and the diaphragm or device upon which the reproduced vibrations are to be impressed by said style, of a metal spring or spring-tongue whose normal vibration is quicker than that of said diaphragm, and whose tension tends to move the style away from the diaphragm, substantially as described.

46. In combination with a diaphragm, a frame having a concave seat for said diaphragm, the walls of said seat converging to an opening in the back, through which the sound may escape, substantially as described.

47. The combination, with the diaphragm and the frame having a concave seat for said diaphragm, of a spring for holding the diaphragm to its seat and for straining the same, substantially as described.

48. The combination, with the diaphragm, its supporting-frame, and the style, of the spring for straining said diaphragm, substantially as described.

49. The combination, with the diaphragm and its supporting-frame, of the spring pressing inward on said diaphragm and the style carried by said spring, substantially as described.

50. The combination, with the diaphragm and its frame, of the spring projecting over said diaphragm, the block between the spring and diaphragm, and the style bearing upon the spring beyond said block, substantially as described.

51. The combination, with the reproducer-style, of the hard-rubber diaphragm and the frame for supporting said diaphragm at the edges, substantially as described.

52. The combination, with a diaphragm and its frame, of a spring projecting over said diaphragm, a style carried by said spring, and a block between the diaphragm and spring, adjustable lengthwise of the latter, substantially as described.

53. The combination, with the reproducer, of the guard fastened over the face of the same, substantially as described.

54. The reproducer provided with a guard



fastened over the face of the same, and curved to form horns upon which the reproducer may rest, substantially as described.

55. The double ear-piece, comprising the elastic and flexible hollow branches provided each with a cup connected with the branch by a ball-and-socket joint, substantially as described.

56. The combination, with the reproducer and the carrier therefor and the feed-screw for moving them, of a sound-conveying tube on the machine-frame and a flexible sound-conveyer between the reproducer and the said tube, substantially as described.

57. The combination, with the reproducer, of the double ear-piece comprising the elastic and flexible hollow branches and the cups jointed to the ends of said branches, substantially as described.

58. The combination, with the feed-screw and the reproducer-carrier supported and capable of turning on said screw, of the reproducer hinged to said carrier and a stop for lifting the reproducer when the carrier is turned in the proper direction, substantially as described.

59. The combination, with the feed-screw and the reproducer-carrier engaging and capable of turning on said screw and provided with an extension or tail, of a movable bar undersaid tail for upholding the same, so that by depressing said bar the carrier can be turned and lift the reproducer from the tablet, substantially as described.

60. The combination of the feed-screw, the reproducer-carrier mounted thereon and provided with an extension or tail, and the bar under said tail for upholding the same, substantially as described.

61. The combination, with the reproducer-carrier, of the reproducer mounted on a standard hinged to said carrier, said standard being provided with a thumb-piece or device, whereby the reproducer can be held up in placing the reproducer on and in removing it from the machine, substantially as described.

62. The combination, with the tablet, tablet-holder, feed-screw, gearing, reproducer,

and reproducer-carrier, of the mechanism for controlling the rotation of said feed-screw the same being connected with said carrier so as to lift the reproducer from the tablet when operated to stop or to reverse the rotation of said screw, substantially as described.

63. The combination, with the tablet-holder and the feed-screw, of the gearing for rotating the feed-screw in the forward direction, the hinged frame for disengaging said gearing when moved a certain distance, and additional wheels connected with said frame, so as by a further movement to engage said wheels and reverse the rotation of said screw, substantially as described.

64. The combination, with the sound recorder or reproducer, the tablet, the tablet-holder, the feed-screw, the gearing for rotating the same in a forward direction, the gearing for rotating the same backward at a greater speed, and mechanism for bringing the latter into action, substantially as described.

65. The combination, with the reproducer and a conveying-tube for the reproduced sounds, of a stop-cock in said tube for moderating at will the loudness of the sounds to be conveyed to the ear, substantially as described.

66. The herein-described improved recording and reproducing machine, comprising the following elements in combination: a hollow cylindrical self-sustaining tablet, a tablet-holder journaled and hinged at one end to the machine-frame and journaled and detachably connected with said frame at the other, a feed-screw, gearing for rotating the said screw in either direction according to the wheels engaged, a hinged frame for controlling the rotation of said screw, and the recording and reproducing instruments with their carriers, substantially as described.

In testimony whereof I have signed the foregoing specification in the presence of two subscribing witnesses.

SUMNER TAINTER.

Witnesses:

PHILIP MAURO,  
O. J. HEDRICK.





(No Model.)

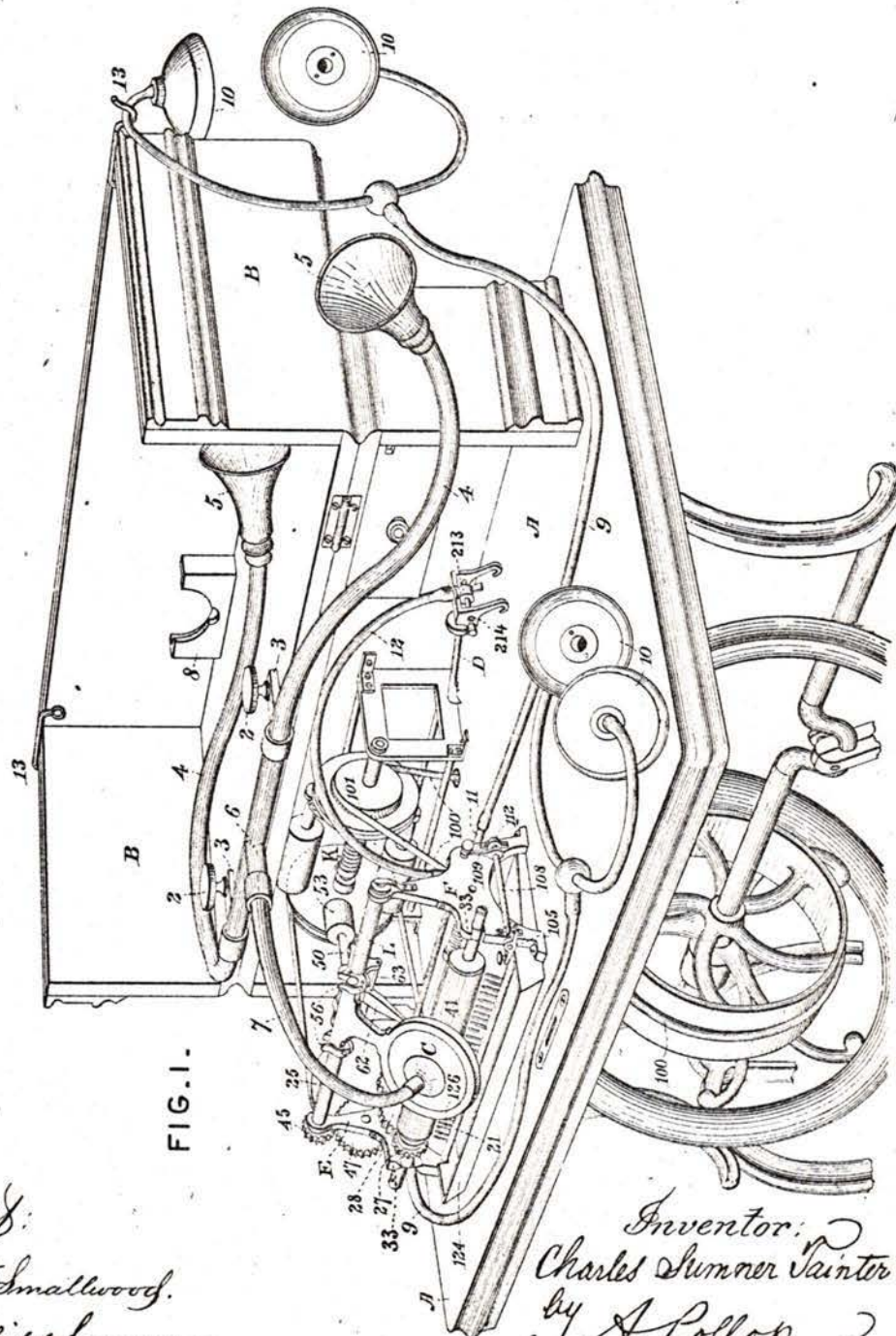
6 Sheets—Sheet 1

C. S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND  
OTHER SOUNDS.

No. 375,579.

Patented Dec. 27, 1887.



Attest:  
Geo. T. Smallwood.  
Philips chair.

Inventor:  
Charles Sumner Tainter  
by A. Pollock  
his attorney.





(No Model.)

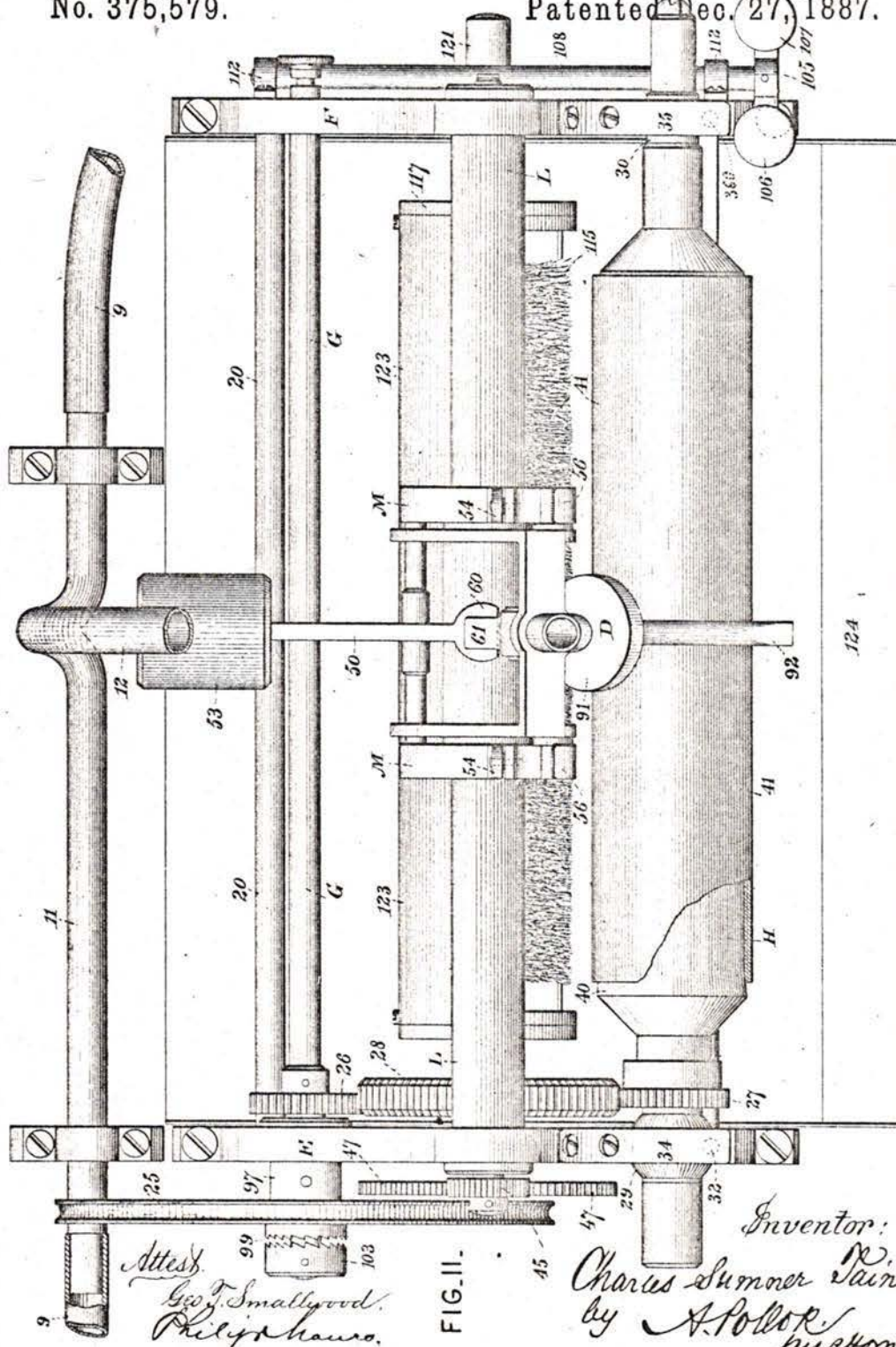
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C. S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND  
OTHER SOUNDS.

No. 375,579.

Patented Dec. 27, 1887.







(No Model.)

6 Sheets—Sheet 3.

C. S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND  
OTHER SOUNDS.

No. 375,579.

Patented Dec. 27, 1887.



Attest.  
Geo. T. Smallwood.  
Thief or house

Inventor:  
Charles Sumner, Painter  
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his attorney.





(No Model.)

6 Sheets—Sheet 4.

C. S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND  
OTHER SOUNDS.

No. 375,579.

Patented Dec. 27, 1887

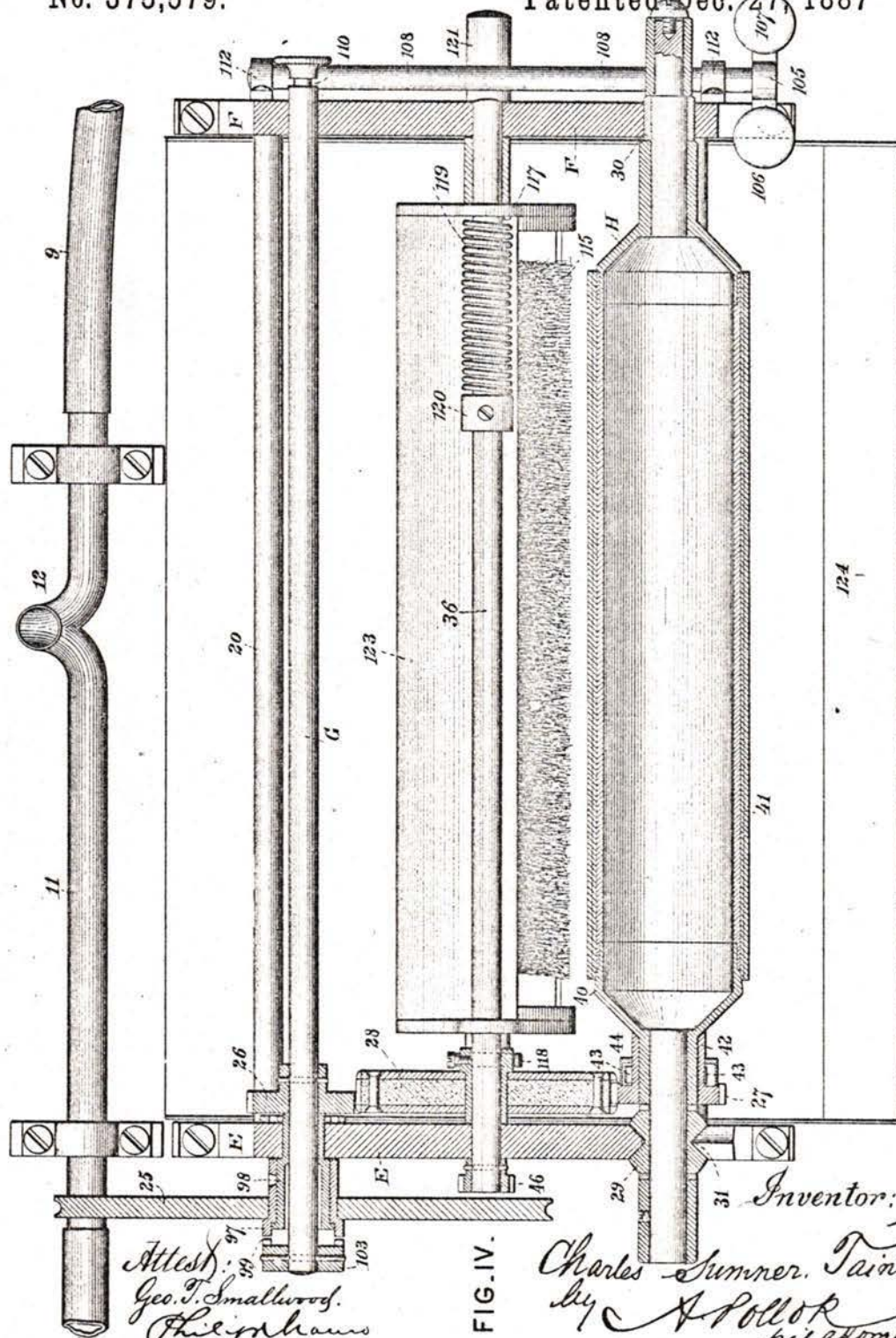


FIG. IV.

Attest:  
Geo. T. Smallwood,  
Philadelphus

Inventor:  
Charles Sumner Tainter  
By A. Pollok  
his attorney.





(No Model.)

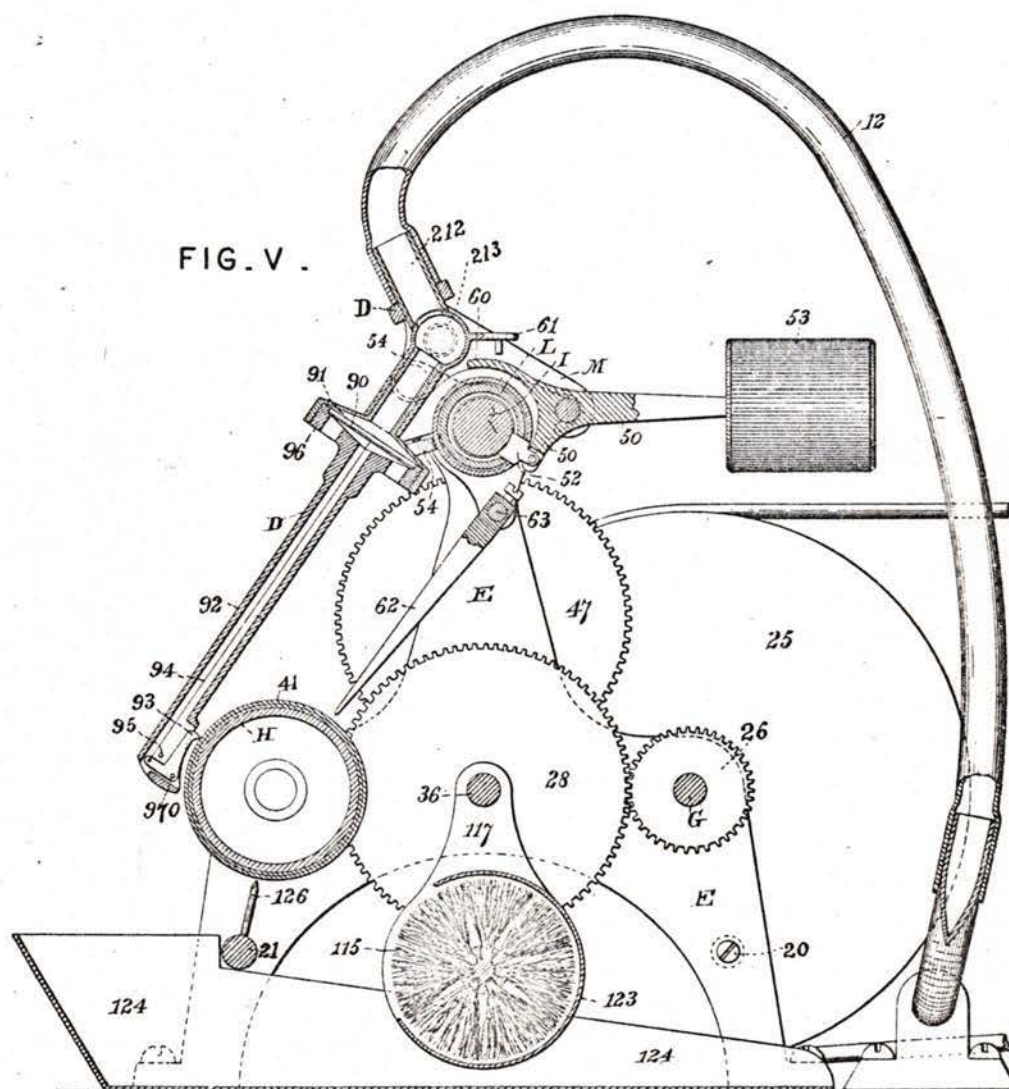
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C. S. TAINTER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND  
OTHER SOUNDS.

No. 375,579.

Patented Dec. 27, 1887.



Attest:  
Geo. T. Smallwood.  
Philip Hamer.

Inventor:  
Charles Sumner Tainter  
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356

(No Model.)

6 Sheets—Sheet 6.

C. S. TAITER.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND  
OTHER SOUNDS.

No. 375,579.

Patented Dec. 27, 1887.

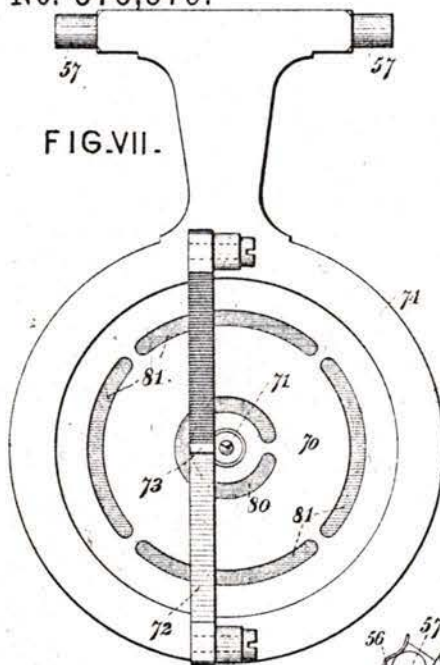


FIG.VII.

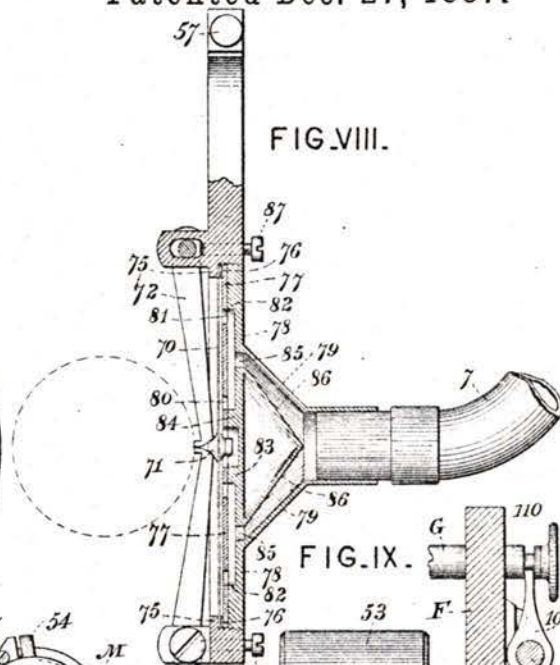


FIG.VIII.

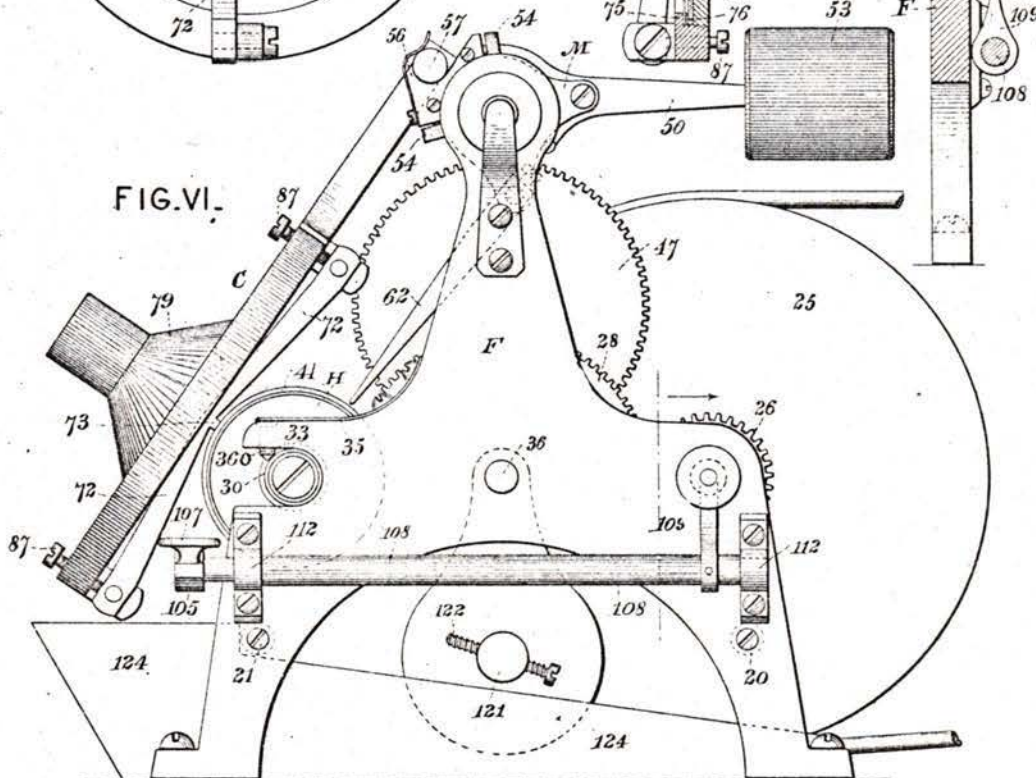


FIG.VI.

Attest:  
Geo. T. Smallwood.  
Philip H. Hays.

Inventor:  
Charles Sumner Tainter by  
Stollor  
his attorney.



# UNITED STATES PATENT OFFICE.

CHARLES SUMNER TAINTER, OF WASHINGTON, DISTRICT OF COLUMBIA

APPARATUS FOR RECORDING AND REPRODUCING SPEECH AND OTHER SOUNDS.

SPECIFICATION forming part of Letters Patent No. 375,579, dated December 27, 1887.

Application filed July 7, 1887. Serial No. 243,601. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES SUMNER TAINTER, a resident of Washington, in the District of Columbia, have invented a new and useful Improvement in Apparatus for Recording and Reproducing Speech and other Sounds, which improvement is fully set forth in the following specification.

This invention relates more particularly to apparatus for recording and reproducing speech and other sounds, known as "graphophones," and comprises certain improvements upon the apparatus described in Letters Patent No. 341,288, granted to me May 4, 1886, and upon instruments of the same type. As described in said patent, the record or "phonogram" is cut or graved by a cutting style in a tablet, consisting of a paper tube or cylinder provided with a coating of wax or wax-like composition, the tablet being mounted on a rotating cylinder or tablet-holder and the recorder or style being advanced lengthwise of the tablet-holder by means of a feed-screw, so as to trace on the tablet a spiral line.

The present invention has for its object to simplify and improve the construction of the apparatus, to render it more complete and convenient for practical use, and to increase its efficiency in point of accuracy and distinctness in recording and reproducing speech and other sounds.

The apparatus is mounted upon a stand or table, and is adapted to be driven by foot-power, or by a small water, spring, electric, or other suitable motor. Upon the stand or table are clamped two or more flexible tubes, terminating in mouth-pieces. At the other end the tubes communicate through a socket and single tube with the recorder. This arrangement is convenient for recording a conversation between two or more persons, as in taking depositions of witnesses. A bracket or holder is provided for receiving the recorder, which can be readily detached from its carriage. Hooks are also provided for hanging the hearing-tubes when not in use. These arrangements conduce greatly to the convenience of the apparatus in practical use.

Heretofore the tablet-holder was on the main shaft. It was provided with a ball-bearing at one end and detachably held in its bearing at the other, so that it could be tilted up to re-

move and replace the tablet. In the present invention the tablet-holder is on an independent shaft and is driven from the main shaft by positive gearing. This simplifies the construction of the apparatus. It also enables the tablet-holder to be readily removed bodily from the machine, which is desirable both to give access to other parts and to enable a fresh tablet to be inserted with the least possible delay.

As this improvement is carried out herein, forked supports are provided in the front of the frame in which the tablet-holder can be readily inserted. The latter has loose collars, one at each end, which fit in the supports and constitute journal-boxes for the shaft. Spring-latches on the frame hold these collars in place, and one of the collars is grooved for engagement with the support, which is beveled to an edge, whereby end motion of the holder is prevented. As the spiral lines formed by the recorder are very close together, it is of the utmost importance to prevent the least end-wise movement of the tablet-holder. The tablets are designed to fit the holder accurately, and heretofore they have been simply slipped on, being held in place by friction. As the tablets are apt to vary somewhat in size, it is preferred to make them a trifle larger than the holder and to make the latter at one end increasing gradually to a little larger diameter, so that the tablet can be pressed toward that end sufficiently to insure a tight fit.

In using ordinary spur-gearing to rotate the holder it is found that the motion of the latter is not absolutely uniform, but proceeds by jerks as one tooth strikes the next. Though this irregularity is very minute and not ordinarily observable, it becomes manifested in the operation of the graphophone. This difficulty is entirely overcome by connecting the driven gear of the tablet-holder with its shaft by a yielding connection. In practice a tolerably stiff spring has been used with excellent results.

Heretofore the carriage of the reproducer and recorder rested directly on the feed-screw. The latter therefore served as a way or track for the carriage. To this construction a lateral shaking or wobbling was incident, which, though actually very slight, it is desirable to avoid. The carriage is now mounted on a



smooth way or track independent of the feed-screw. Preferably the way or track is a fixed tube and the feed-screw is placed within it. The carriage carries a nut which engages and is driven by the thread of the feed-screw. The connection between the nut and carriage is a lever-arm passing through a longitudinal slot in the tubular track. The lever carries a weight which serves both to press the nut against the screw and also to counterbalance the weight of the recorder or reproducer and its accessories. The carriage in the present invention is a permanent part of the apparatus, being used with both recorder and reproducer. Preferably the carriage has small anti-friction rollers in contact with the cylinder, and these are arranged relatively to the nut to insure the greatest freedom of motion to the carriage. The lever-arm, carrying the nut and weight, and the tail-piece of the reproducer have each a finger-piece, which, when the reproducer is in place, are in such position as to be simultaneously operated to raise the nut from the screw and the style from the record, enabling the carriage to be moved back or forward, as desired. To insure accurate setting, an indicator-finger with its point close to the surface of the tablet-holder is attached to the carriage.

As heretofore made the recorder did not act as efficiently in recording sounds of high pitch as in recording sounds of lower pitch. This is believed to be due to the fact that when the sound-waves impinge directly against the center of the diaphragm the latter does not act as a unit, for if the sounds are sufficiently high two or more waves in opposite phases may, owing to the length between the center and circumference of the diaphragm, be acting upon it at the same time, and a differential effect is the result instead of the full force of the wave. This difficulty may be overcome by constructing the sound-conveying passage to the diaphragm in such manner that the atmospheric vibrations will act simultaneously upon the whole surface of the diaphragm. The best embodiment of this principle would be to construct a large air-chamber of conical form in front of the diaphragm, communicating at its apex with the mouth-piece; but this plan is not feasible, because the vibratory air-space in front of the diaphragm must be made very thin, or otherwise a disagreeable hollow quality is manifested in the reproduced sound. The object sought, however, may be practically attained without dispensing with the thin air-space, which is found to be advantageous, by dividing the sound-conveying passage as it approaches the diaphragm into a number of branches equal in length and communicating with different points on the surface of the diaphragm, whereby the latter is caused to vibrate with practical uniformity in every part, even with sounds of high pitch. This improvement obviously permits the use of a larger diaphragm than could heretofore be used with advan-

tage, and it is applicable to other apparatus employing a diaphragm operated by sonorous vibrations.

Successful reproduction from graphophonic records which have been properly made depends largely upon the sensitiveness of the reproducing-style and its ability to follow closely the irregularities of the record, bearing always on it with uniform pressure and not skipping from one elevation to the next, as is the tendency. The elevations and depressions of the sound-record being so minute, and following in such rapid succession, make it difficult to insure that the point of the reproducing-style shall descend fully into each depression.

Heretofore the standard of the reproducer has been pivoted at one end and at the other provided with the diaphragm and style, the reproducer resting by its own weight upon the record, and being thus left free to follow its irregularities. To assist, further, its action a light spring has been arranged to bear upon the style and insure its quick return after passing an elevation in the record. It is found in practice that the weight of the diaphragm and mountings upon the free end of the reproducer-standard is too great to secure the best results, and that the device is rendered more efficient in action by reducing this weight. To this end the diaphragm is now placed nearer the other end of the standard, and therefore falls mainly on the fulcrum of the standard, instead of on the record, and it is connected with the style by a thread.

The style itself consists of a lever on one arm of which is the point that rests on the record, and to the other arm of which the thread leading from the diaphragm is attached. By this construction the pressure of the reproducer on the record is greatly reduced and the style is made to follow the record more accurately. Moreover, when the lever constituting the style rests upon the record, the diaphragm through the thread is pulled toward the style, and thereby held under tension. This tension increases as the style ascends a ridge and reacts to compel it to enter the succeeding depression. As before, the style is made flexible laterally to enable it readily to follow the grooves in the bottom of which the record is formed.

For convenience in stopping and starting the machine without interrupting the operation of the motor a clutch mechanism is combined with the main shaft. The clutch can be operated by a key-lever conveniently placed near the front of the machine. This contrivance is of great utility in transcribing from the record on a type-writer, for instance, it being, of course, difficult for the operator to transcribe as rapidly as the record is reproduced. By means of the clutch mechanism the machine can be stopped after a sufficient number of words have been reproduced until the latter have been transcribed or repeated to another person, when the machine can be instantly started again.



Heretofore the fine wax thread or shaving removed by the cutting-style has been brushed off by hand, and its entire removal has been further insured by attaching a small brush to sweep over the record in front of the reproducer. In the present apparatus a rotary brush is employed having on its shaft a pinion which can be engaged with one of the gears at the same time that the brush touches the surface of the tablet. The brush is preferably made a permanent part of the machine, being carried by a swinging frame attached to one of the shafts. When the record has been cut, the brush can be swung into contact with the tablet, and, by a slight endwise movement, a pinion carried by the brush-spindle is thrown into gear with one of the spur-wheels, and the brush is thereby rapidly rotated while the tablet revolves, completely removing the wax shavings, which fall into a tray placed under the machine. The wax thread or shaving has a tendency to wrap itself around the tablet as the latter revolves, thereby interfering somewhat with the operation of the apparatus. This is now prevented by a comb or saw-toothed plate placed lengthwise of the tablet, with its teeth in close proximity to the surface of the latter.

In addition to the improvements above indicated the invention includes certain new details of construction and combinations of parts, which will be hereinafter fully pointed out.

Having now explained the general principle of the invention, the best mode contemplated of carrying the same into effect will now be described in connection with the accompanying drawings, which form part of this specification.

Figure I is a perspective view of the apparatus arranged upon a stand or table, the recorder being shown in its operative position; Fig. II, a plan view of the graphophone proper; Fig. III, a front elevation with parts of the tray broken away to show the parts behind. Fig. IV is a sectional plan view; Fig. V, a vertical section in elevation looking to the left and showing the reproducer in place. Fig. VI is an elevation of the right end, Fig. II, of the machine, showing the recorder in place. Fig. VII is a bottom view of the recorder. Fig. VIII is a central longitudinal section thereof, and Fig. IX is a detail view of a portion of the clutch mechanism.

Referring to Fig. I, A is the stand or table upon which are placed the working parts of the apparatus. The stand A has a hinged lid, B, which in use is thrown back, forming a shelf. To the front edge of this shelf are attached by clamp-screws 2 the holder 3 for flexible tubes 4. Two tubes are shown, but a greater number could be applied in the same way. At their outer ends the tubes 4 terminate in mouth-pieces 5, and at the other ends they connect with a hollow bifurcated socket 6, connected by a tube, 7, with the recorder C. At the rear of the shelf B is a bracket, 8, in

which the recorder C is placed when not in use, so that, with its attachments, it is entirely out of the way while reproducing. The arrangement is found to be of great utility in recording conversations and in taking depositions. The reproducer D is in like manner provided with two hearing-tubes, 9, terminating in ear-pieces 10, such as described in the Letters Patent aforesaid. These tubes 9 connect with opposite ends of a metal tube, 11, screwed to the stand A, from which a flexible tube, 12, leads to the reproducer D. Hooks 13 are pivoted to the back of lid B, and upon them the tubes 9 are hung when not in use. These hooks can be turned inside the lid B when the latter is to be closed.

The motor for driving the graphophone may be located beneath the stand or table A, and may be a treadle, for example. Power is transmitted from such motor by a belt, 100, to the pulley 101 of a speed-regulator, K. The latter may be of any suitable construction, and, as it forms no part of the present invention, need not be particularly described. Its object is to prevent the graphophone from being driven beyond a determined maximum speed, regardless of the speed of the motor.

Referring now to Figs. II to IX, which show the graphophone proper, the frame-work of the apparatus consists of two uprights or standards, E F, and tie-rods 20 and 21. The main shaft G is supported in bearings in the uprights E F. It is driven by the pulley 25, through which it is rotated from a suitable motor by a belt, and it carries a spur-gear, 26, which transmits motion to the other working parts. The tablet-holder H has a gear, 27, which is driven by gear 26 through an intermediary, 28, on shaft 36. The gear 28 is formed of a disk of leather or other suitable material clamped between two metal disks, the object being to prevent noise in operation. Tablet-holder H is detachably supported in a forked support in the front of uprights E F. It has at the ends loose collars 29 and 30, which, when the tablet-holder is in place, are in contact with the frame, and they constitute the bearings or journal-boxes in which the holder revolves, being held stationary in operation. Collar 29 is formed with a groove, 31, and the recess in which it rests is provided with an edge that enters this groove and prevents end motion of the tablet-holder. The pin 32 passes through a hole in the projection 33 of the upright E, and is pressed down by a leaf-spring, 34, which holds the pin against the collar 29 with sufficient pressure to keep the tablet-holder in place. A similar spring-latch, composed of the spring 35 and the pin 360, (see Fig. VI,) is arranged on the upright F to act upon the collar 30. The surface of the latter is smooth. The construction shown permits the tablet-holder to be instantly removed bodily from the machine and as quickly put back in place, thereby avoiding any considerable delay in the use of the machine when a fresh tablet has to be inserted. The tablet-holder



increases at one end to a slightly-larger diameter, as shown at 40, Figs. III and IV, so that the tablet 41, being pressed toward that end, will be held sufficiently tight to prevent slipping, even though the tablet fits quite loosely with respect to the main portion of the holder.

The gear 27 is fixed not directly to the tablet-holder II, but to a collar, 42, mounted loosely on the spindle of said holder. This collar is connected with the holder by a curved spring, 43, so that the connection between the holder and its gear is a yielding one. The curved spring 43 extends more than half-way around the collar, being fastened at one end to the latter and at the other to the tablet-holder, the collar 42 being cut away to permit this connection to be made. The object of this is to prevent minute vibrations being imparted to the tablet from the toothed gearing and to insure absolute uniformity of motion. Such vibrations are absorbed or taken up by the spring 43. The spring is covered by the sliding cap 44.

The feed-screw I is placed near the top of the apparatus and is supported in bearings in uprights E F. It carries a pinion, 45, which is driven by the main shaft through gear 26, intermediary 28, pinion 46 on the same shaft, 36, that carries the gear 28, and spur-gear 47. The feed-screw I is thus driven at a much lower speed than the tablet-holder II.

Feed-screw I, Fig. V, is inclosed in a hollow tube, L, which forms the guide way or track for the carriage M. To the latter is pivoted a lever-arm, 50, which extends to the rear of tube L. This tube has a slot therein which extends lengthwise of the sleeve to the limits of the movement of the carriage in both directions. The arm 50 carries at its end the segment of a nut, 52, having threads corresponding in pitch to those of the feed-screw I, which it engages. The nut 52 is held in engagement with the feed-screw by the pressure of weight 53, which is also carried by lever-arm 50.

The carriage M is designed to slide freely on the guide tube or way L, which it surrounds. It carries four small anti-friction wheels or rollers, 54, which are in contact with the surface of the tube L, the carriage itself not being in contact with the tube at all. The upper and lower pairs of wheels 54 are placed about one hundred degrees apart with respect to the circumference of the tube L, and they are about equidistant from nut 52, so that the bearing-points of the carriage are nearly equidistant and its pressure evenly distributed around its axis, thereby reducing friction to a minimum.

The thread of the feed-screw may be cut away at the right-hand end to stop the carriage when it reaches the end of its movement.

The carriage has in front a pair of sockets, 56, adapted to receive the trunnions 57 of the recorder C or reproducer D. The carriage M is a permanent part of the apparatus, being

used with both recorder and reproducer. As the weight 53 is at the rear of the carriage, it not only acts to keep the nut 52 in engagement with the feed-screw, but also serves to counterbalance the weight of the recorder or reproducer, whichever happens to be in use.

The forward projection of the lever-arm 50 has a finger-piece, 60, Fig. II, by pressing upon which the nut 52 can be lifted out of engagement with the feed-screw and the carriage can be slid to any desired point. The reproducer D has also a finger-piece, 61, which overlaps the finger-piece 60. Thus, by pressing upon the part 61, the style of the reproducer is lifted from the record at the same time that nut 52 is disengaged from the feed-screw. This arrangement permits the carriage and parts connected with it to be moved back and forward—as, for instance, if it be desired to repeat any portion of the recorded speech or sound.

When the recorder or reproducer is in place, it is difficult to set its style accurately at any desired point. To obviate this difficulty the carriage M has a finger or pointer, 62, carried by a rod, 63. The point of the finger 62 approaches close to the surface of the tablet, and said point is in the same vertical plane transverse to the axis of the tablet as the style of the recorder or reproducer when in place in the carriage. Consequently, by means of the finger 62, the carriage can be set accurately at the desired point, and the recorder (or reproducer) then put in place.

The manner of constructing and mounting the carriage M, in addition to other advantages, prevents lateral vibration or wobbling, and one result of this is that the spiral lines of the record can be made closer together than was practicable heretofore. With the apparatus as described the relative speeds of the feed-screw and tablet-holder are so timed that the recorder traces one hundred and fifty-four lines to an inch on the tablet, thus largely increasing the capacity of the tablets.

The recorder C (see Figs. III, VI, VII, and VIII) is in most respects the same as in my Patent No. 341,288. It has the diaphragm 70, of mica, to the center of which is attached the cutting-style 71 and the adjustable bar or bridge-piece 72, having a smooth-surfaced enlargement, 73, at its middle for resting on the surface of the tablet and regulating the depth of the cut to be made by the style 71. It is attached to the carriage, as already explained, by placing the trunnions 57 in the sockets 56; from which it hangs downward and rests by gravity on the tablet 41.

The frame of the recorder consists of a metal ring, 74, with an internal shoulder or flange, 75, at its lower edge, upon which flange the mica diaphragm 70 is placed. Upon the diaphragm is a washer, 76, of yielding material—such as thick paper or card-board—and upon this is placed the metal disk 77, forming a thin air space or chamber in front of the diaphragm. These parts are held in place by the



top piece, 78, which is screwed into the ring 74. The top piece, 78, has a central cone, 79, terminating in a socket at its apex for the attachment of a speaking-tube or mouth-piece.

5 The disk 77 has a series of openings or passages, 80 81, for the sonorous vibrations. These are shown as slots arranged in two concentric rings. These rings are disposed so as to affect equally as nearly as possible all  
10 parts of the diaphragm, the distance between the openings 80 and 81 being equal to the distance from the latter to the edge of the diaphragm and to the distance across the inner ring, 80.

15 The object is to divide the sound - passage, so that the sonorous vibrations will act simultaneously against different parts of the diaphragm, instead of being concentrated at its center, and thus cause it to vibrate uniformly  
20 over its entire surface. To carry out this principle it is important that all the sound-passages should be of the same length, which is secured by the construction of the top piece, 78. This is provided at its lower side  
25 with an annular shoulder, 82, which bears upon and clamps the edge of disk 77, and with a plate or disk, 83, which extends across it and forms an annular air-chamber in front of the disk 77. Disk 83 has shoulder 84 at its  
30 center, which bears upon the disk 77 between the first series of slots, 80, and the center. Disk 83 has a single series of openings or slots, 85, arranged in a ring midway between the series 80 and 81 of the disk 77. The openings 85  
35 communicate with air-passages formed between the outer cone, 79, and an inner deflecting-cone, 86. Thus it will be seen that the sonorous vibrations after reaching the apex of the cone 86 are propagated through a  
40 number of passages, all of the same length, but communicating with different points on the surface of the diaphragm. Upon the same principle the number of sound-passages may be multiplied by increasing the number  
45 of perforated disks interposed between the top piece and the diaphragm. The set-screws 87, passing through the frame 74, are for adjusting the position of the bridge-piece 72, and thus regulating normal depth of penetration of the style 71 into the wax coating of  
50 the tablet.

The reproducer D is best shown in Fig. V. It is hung in the carriage M in the same manner as the recorder, and the point of the rubbing-style rests by gravity upon the tablet  
55 41, as heretofore.

The diaphragm 90 is inclosed in a case or chamber, 91, near the upper end of the reproducer-standard 92, or the end away from that which carries the style 93. The style is  
60 thus partially freed from the weight of the diaphragm and its mountings and rests more lightly on the tablet. The style 93 is an elbow or bell-crank lever pivoted at 970 in  
65 the end of the hollow standard 92, with its point projecting slightly beyond the end

thereof. The style is made preferably of spring metal, so that while rigid in the direction of its normal movement it is flexible laterally, and is therefore not liable to slip  
70 out of the groove in the tablet.

The inner arm of the lever 93 is connected by a thread, 94, with the center of the diaphragm 90, the thread being inclosed in the hollow standard 92. The pin 95 acts as a stop  
75 to limit the extent to which the point of the style projects beyond its casing. The plate 96, which covers the rear of the diaphragm and to which the hollow standard 92 is attached; is perforated, so that the space behind the dia-  
80 phragm is in communication with the outer air, whereby interference, which would to a certain extent result from reverberation, is prevented. All the working parts of the re-  
85 producer are thus inclosed and protected from damage that might result from careless handling. When the reproducer is in place, with the point of style 93 resting upon the record, the weight is sufficient to turn the style slightly  
90 on its pivot, pulling on the thread, and thus putting the diaphragm under tension. The tendency of the diaphragm to return to its normal position when pulled out by the motion of the style assists in causing the latter to follow closely the irregularities of the record  
95 and to descend fully into the depressions thereof.

One advantage of using a lever as the reproducing-style is that by making the inner arm shorter than the outer, as shown in the  
100 drawings, the motion of the diaphragm can be reduced; which, though it involves a slight loss in loudness, is found to produce a more than compensating gain in distinctness of enunciation.

The end of the flexible sound-conveying tube 12 fits over the upper end of a tube, 212, which is fixed in the frame of the reproducer D, and whose lower end, though not in contact, is in close proximity to the socket-piece  
110 213, around the opening in the periphery of said piece for the passage of the sound-waves into the tube 12. The advantage of this construction is that the socket-piece may turn or vibrate on its pivots 214 without friction. It  
115 is found that there is no appreciable loss of loudness in the sounds reproduced, with a space of, say, two one-thousandths of an inch all around.

The apparatus can be started and stopped  
120 at will by means of clutch mechanism, which will now be described. (See Figs. II, III, IV, and IX.) The driving-pulley 25 is mounted not directly on the main shaft G, but on a stud, 98, fastened to upright or standard E, through  
125 which the shaft passes. The hub 97 of the pulley 25 has a serrated edge, 99, constituting one member of a clutch. The boss 103, which is fast on the main shaft G, has a corresponding serrated edge and constitutes the other  
130 member of the clutch. The main shaft G can be moved lengthwise in its bearings suffi-



ciently to engage and disengage the member of the clutch, and thereby stop or start the machine, as desired.

For greater convenience in operating the clutch a key-lever, 105, with two buttons, 106 and 107, is placed at the front of the upright F and fixed on the end of a rock-shaft, 108, having bearings in brackets 112, screwed to upright F. The rock-shaft at its rear end carries an arm, 109, whose point takes into a groove, 110, (see Fig. IX,) in the main shaft. By pressing on button 107 the main shaft is shifted to the right, the members of the clutch thrown into engagement, and the machine started. By pressing on button 106 the shaft is moved to the left, and the pulley 25 thereby disengaged from the shaft and allowed to revolve idly, the shaft coming to rest.

The cylindrical brush 115 is mounted on a spindle, 116, which has bearings in the swinging brackets 117, and carries on one end a pinion, 118, Fig. III. The brackets 117 hang loosely from shaft 36, so that, except when the brush is actually in use, it hangs clear of the other parts of the apparatus. A spiral spring, 119, encircles shaft 36 and bears at one end against a collar, 120, on said shaft, and at the other against bracket 117, and therefore tends to keep the brush in such position that the pinion 118 is out of the plane of gear 28. To use the brush, the operator swings it forward by grasping the stud 121, which is on the end of the brush-spindle 116, and at the same time pushes the brush to the left, thereby throwing the pinion 118 into engagement with gear 28, rapidly rotating the brush against the surface of the tablet, which is also in motion, and clearing it of all the cuttings of wax, which fall into the tray 124. When the brushing is complete, the operator releases it, and it falls by gravity to its normal position, the spring 119 throwing the whole frame to the right and moving pinion 118 out of the plane of rotation of gear 28. The brush 115 is inclosed for the greater part of its periphery in a casing, 123, which acts as a guard to prevent scattering of the shavings, and also partly as a frame to hold the parts together.

The screw 122, Fig. VI, passes through the stud 121. When the brush is raised, its point strikes the underside of upright F, thus limiting the motion of the brush in the direction of the tablet. The screw 122 can be adjusted to secure the proper pressure of the brush against the tablet.

The comb 126, Figs. III and V, extends across the machine below the tablet-holder, being mounted on tie-rod 27. Its teeth approach to within, say, one thirty-second ( $\frac{1}{32}$ ) of an inch of the surface of the tablet 41. The teeth of this comb will catch the fine wax shaving cut by the recording-style and prevent its winding itself around the tablet.

A thin plate having a saw-tooth edge may be substituted for the comb with equally good

effect and will be less expensive in construction.

The tablet 41 is preferably such as described in my application for Letters Patent No. 236,304, filed April 27, 1887.

It is obvious that modifications may be made without departing from the spirit of the invention, and that some of the improvements may, if desired, be used without others.

Having now fully described the said invention and the manner in which the same is or may be carried into effect, what I claim is—

1. In an apparatus for recording and reproducing sounds, the combination, with the recorder, of a flexible tube or tubes provided with mouth-pieces and communicating with the space in front of the diaphragm of said recorder, and clamps or holders for attaching said tubes to the stand or table, substantially as described.

2. The combination, in a sound recording and reproducing apparatus, of the recorder, a tube leading to the diaphragm thereof, two flexible tubes connected with said first-named tube by a two-armed socket, and clamps or holders for said tubes detachably secured to the stand or table, substantially as described.

3. The combination of the recorder, a flexible tube or tubes communicating with the space in front of the diaphragm of said recorder, clamps or holders for attaching said tubes to the stand or table, and a bracket or holder for said recorder when not in use, substantially as described.

4. The combination, in a graphophone, of the frame, the main shaft supported in bearings therein, the tablet-holder removably supported in said frame, and gearing for rotating said tablet-holder from the main shaft, substantially as described.

5. The combination of the frame provided with forked supports, the spring-latches, and the tablet-holder having collars, one at each end, for insertion in said supports, said collars constituting the journal boxes or bearings for the tablet-holder, substantially as described.

6. The combination of the frame having forked supports, the cylindrical tablet-holder, the collars thereon adapted to rest in said supports, one of said collars being grooved, and the spring-latches for holding the tablet-holder in said supports, substantially as described.

7. The cylindrical tablet-holder increasing at one end to a larger diameter than the main portion of the holder, substantially as described.

8. In a graphophone, the combination, with the main shaft, of the tablet-holder, a gear-wheel connected therewith by a yielding connection, and gearing for driving said tablet-holder from said main shaft, substantially as described.

9. The combination of the main shaft, the



tablet-holder, a gear mounted on a collar loose on said holder, a spring connecting said collar and holder, and intermediate gearing between said shaft and holder, substantially as described.

10. The combination, with the recorder and reproducer, of the carriage having sockets for supporting the same, a stationary track or way on which said carriage slides, a feed-screw, and a nut carried by said carriage and engaging said screw, substantially as described.

11. The combination of the fixed tube having a longitudinal slot, the feed-screw within said tube, the carriage sliding on said tube, the arm attached to said carriage, and the nut carried by said arm and engaging said screw, substantially as described.

12. The combination of the fixed tube, the inclosed feed-screw, the carriage sliding on said tube, and the nut engaging said screw, and the pivoted arm carrying said nut, whereby the latter may be disengaged from said screw, substantially as described.

13. The combination of the fixed tube, the inclosed feed-screw, the carriage, the anti-friction wheels on said carriage in contact with the surface of said tube, the lever-arm, and the segment of a nut carried thereby and engaging said feed-screw, said wheels and nut, which constitute the bearing-points of the carriage, being arranged at approximately equal distances apart with respect to the axis thereof, substantially as described.

14. The combination, with the fixed tube, the carriage sliding thereon, and the feed-screw, of a lever-arm pivoted to said carriage, a nut on said arm, and a weight for holding said nut in engagement with said feed-screw, substantially as described.

15. The combination of the fixed tube, the carriage sliding thereon, the feed-screw, the nut engaging therewith, the lever carrying said nut and pivoted to said carriage, and the reproducer pivoted in said carriage and having a projection overlapping the end of said lever, so that by pressing on said projection the style is lifted from the record and the nut simultaneously disengaged from the feed-screw, substantially as described.

16. The combination, with the tablet-holder, of the sliding carriage for the recorder and reproducer, said carriage being provided with an indicator-finger having its point close to the surface of the tablet-holder, substantially as described.

17. In a sound recording or transmitting device, the combination, with a diaphragm responsive to sonorous vibrations, of a disk forming an air-chamber in front of said diaphragm, said disk being provided with a number of apertures arranged in series, dividing the diaphragm into rings of equal width, and said apertures being connected with a common mouth-piece, substantially as described.

18. The combination, with the diaphragm and a sound-conveying tube, of a conical de-

flector having its apex in the axis of said tube, a casing or top piece, and a perforated disk or disks interposed between said top piece and the diaphragm, the perforations of said disks being so disposed as to constitute sound-passages all of the same length, but leading to different points on the surface of the diaphragm, substantially as described.

19. In a graphophone, the combination, with the tablet-holder and feed-screw, of the sliding carriage provided with sockets and a recorder having trunnions for resting in said sockets, whereby it can be readily placed on and removed from said carriage, substantially as described.

20. The combination, with the diaphragm of the reproducer, of the rubbing-style consisting of a lever having the rubbing-point formed on one arm and the other connected with said diaphragm, substantially as described.

21. In a reproducer adapted to rest by gravity on the record, the combination, with the standard, of a style supported in the free end thereof, a diaphragm mounted near the other end thereof, and a connection between the style and diaphragm, substantially as described.

22. The combination of the standard, the style consisting of a lever pivoted at one end thereof, the diaphragm supported near the other end, and a thread connecting one arm of said lever with the diaphragm, substantially as described.

23. The combination of the hollow standard, the diaphragm mounted therein, the style pivoted in the end thereof, and the thread inclosed in said hollow standard and connecting the style and diaphragm, substantially as described.

24. The combination, with the diaphragm, of the pivoted style, said style being connected with the diaphragm at a point nearer its fulcrum than the point that rests on the record, substantially as described.

25. In a graphophone, the combination, with the main shaft, the feed-screw and tablet-holder, and gearing for driving the same from said main shaft, of a clutch for starting and stopping said shaft at will, substantially as described.

26. In a graphophone, the combination, with the main shaft, the feed-screw and tablet-holder, and gearing for driving the same from said shaft, of a wheel or pulley for driving said shaft, mounted loosely thereon, and a clutch for engaging said shaft with said pulley or wheel when desired, substantially as described.

27. In a graphophone, the combination, with the main shaft, driving-pulley, tablet-holder, and carriage for the recorder or reproducer, operated from said main shaft, of the clutch mechanism for connecting and disconnecting said shaft and pulley and the key-lever carried by a rock-shaft connected at one end with said main shaft for operating said clutch mechanism, substantially as described.



28. The combination, with the tablet and tablet-holder and driving mechanism for the latter, of a rotating brush having a pinion on its spindle adapted to engage one of the gears of the machine when the brush is brought against the surface of the tablet, substantially as described.

29. The combination, with the tablet, tablet-holder, and driving mechanism, of the cylindrical brush having bearings in a swinging frame, so as to hang normally free of said tablet, but adapted to be brought into contact therewith and simultaneously thrown into gear with said driving mechanism, substantially as described.

30. The combination, with the tablet, tablet-holder, and driving mechanism, of the brush having bearings in a swinging frame hanging clear of the tablet, a pinion for engaging one of the gears, and a spring for moving the frame laterally to hold said pinion normally out of the plane of rotation of said gear, substantially as described.

31. The combination of the tablet-holder,

the wax-coated tablet, the cylindrical brush carried in a swinging frame, and the tray beneath the brush and tablet, substantially as described.

32. The combination, with the tablet and tablet-holder, of the toothed plate or comb lengthwise of said tablet and having the points of its teeth in close proximity to the surface thereof, substantially as described.

33. The combination, with the pivoted reproducer having a suitable socket-piece provided with a sound-opening on its periphery, of a sound-conveying tube having its end in close proximity to the said socket-piece around the said opening, leaving a small space, so as to avoid friction, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHARLES SUMNER TAINTER.

Witnesses:

ROBINSON WHITE,  
O. J. HEDRICK.





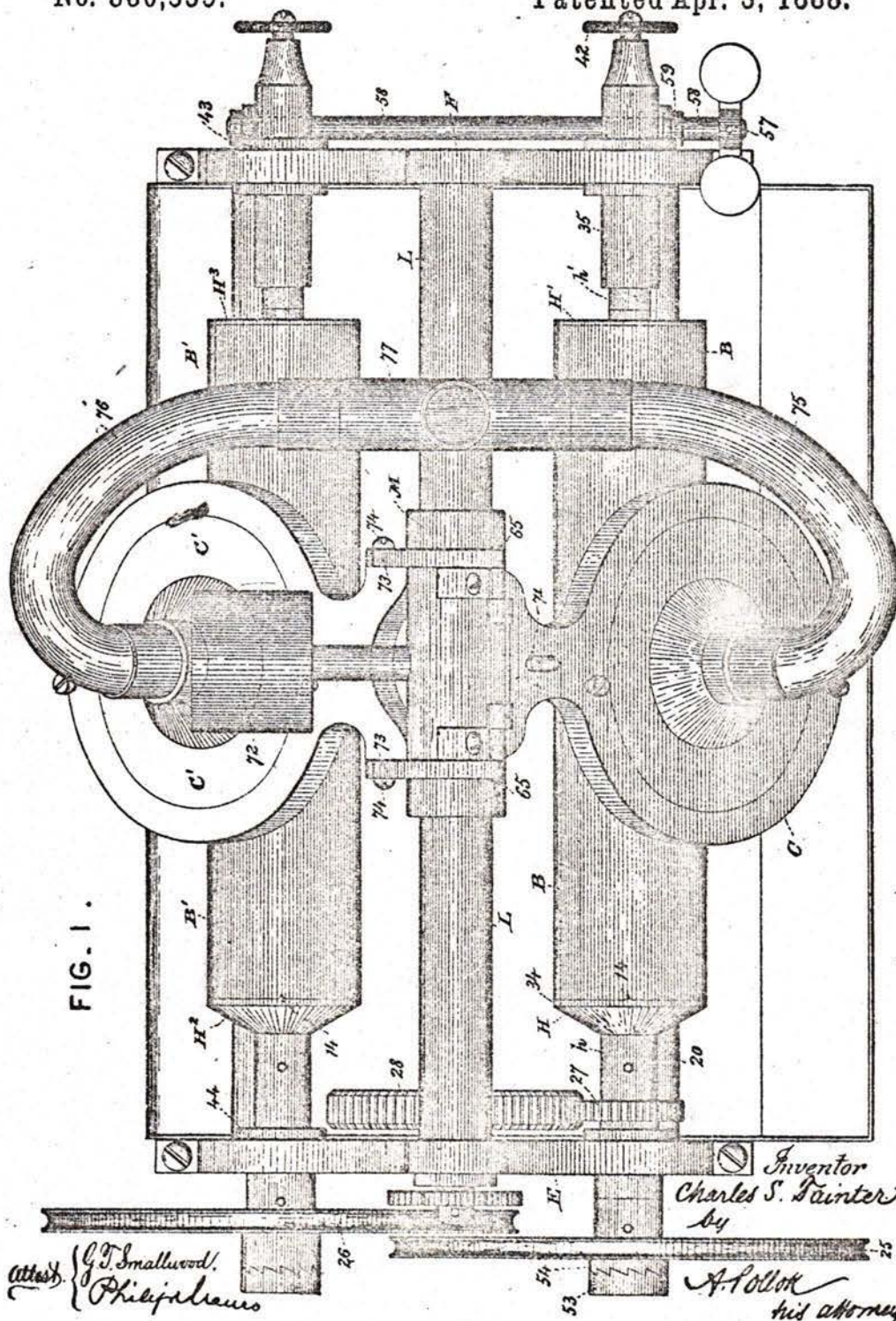
(No Model.)

4 Sheets—Sheet 1.

C. S. TAINTER.  
GRAPHOPHONE.

No. 380,535.

Patented Apr. 3, 1888.







(No Model.)

4 Sheets—Sheet 2.

C. S. TAINTER.  
GRAPHOPHONE.

No. 380,535.

Patented Apr. 3, 1888.

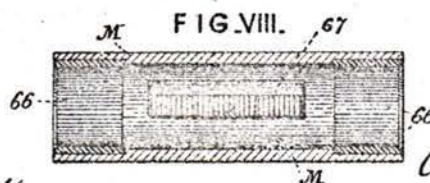
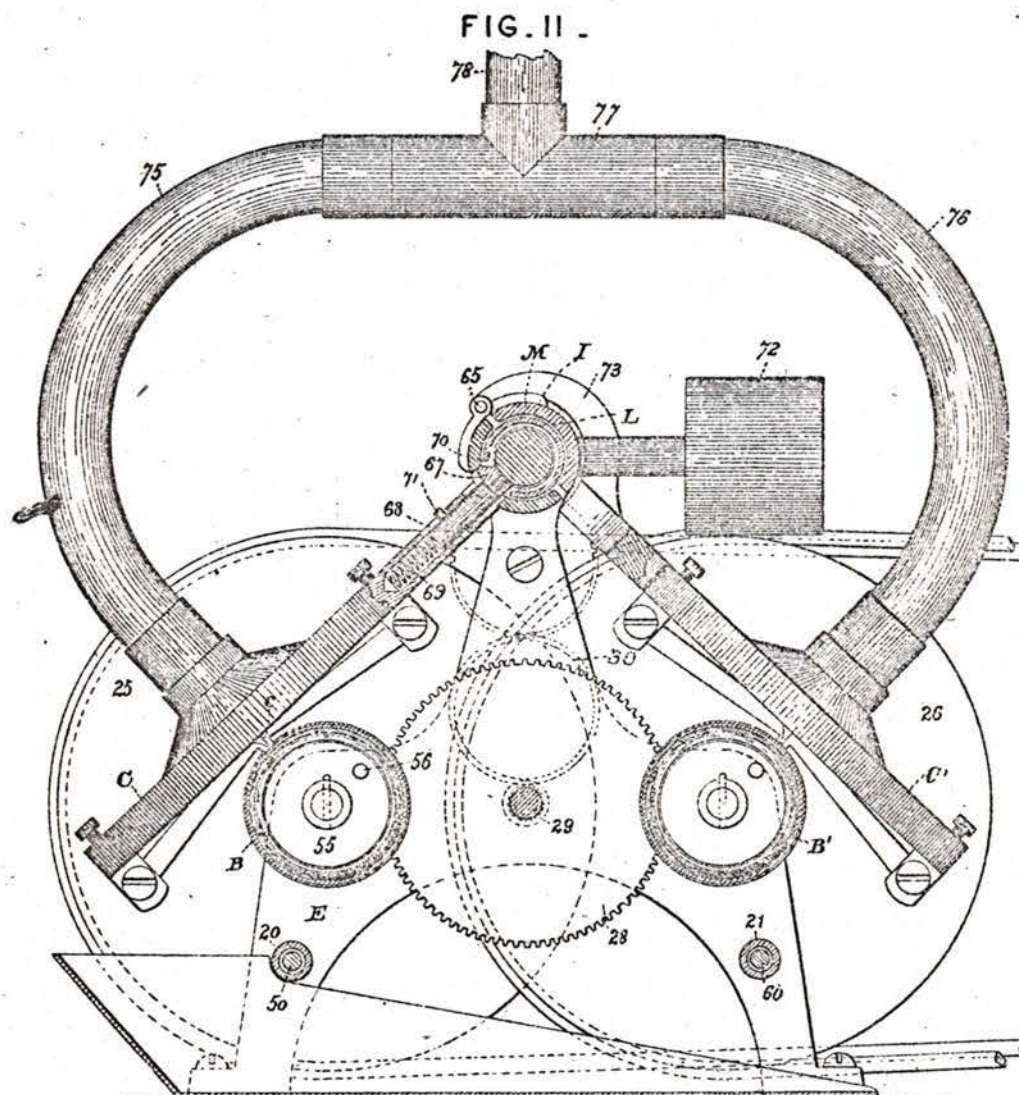


FIG. VII.

Attest:  
Geo. T. Smallwood,  
Philadelphus.

Inventor  
Charles S. Tainter.  
by A. Poller  
his attorney.





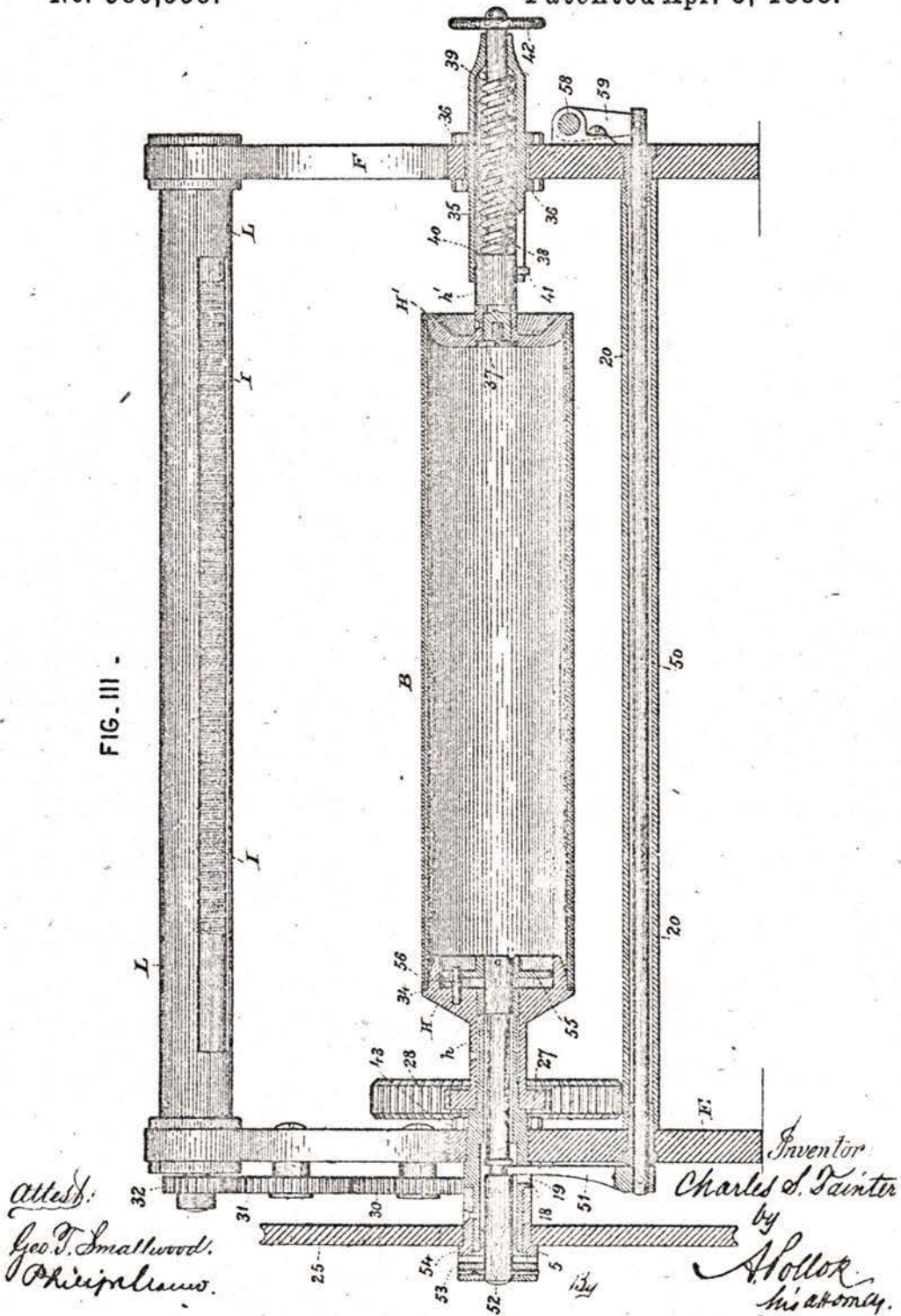
(No Model.)

4 Sheets—Sheet 3.

C. S. TAINTER.  
GRAPHOPHONE.

No. 380,535.

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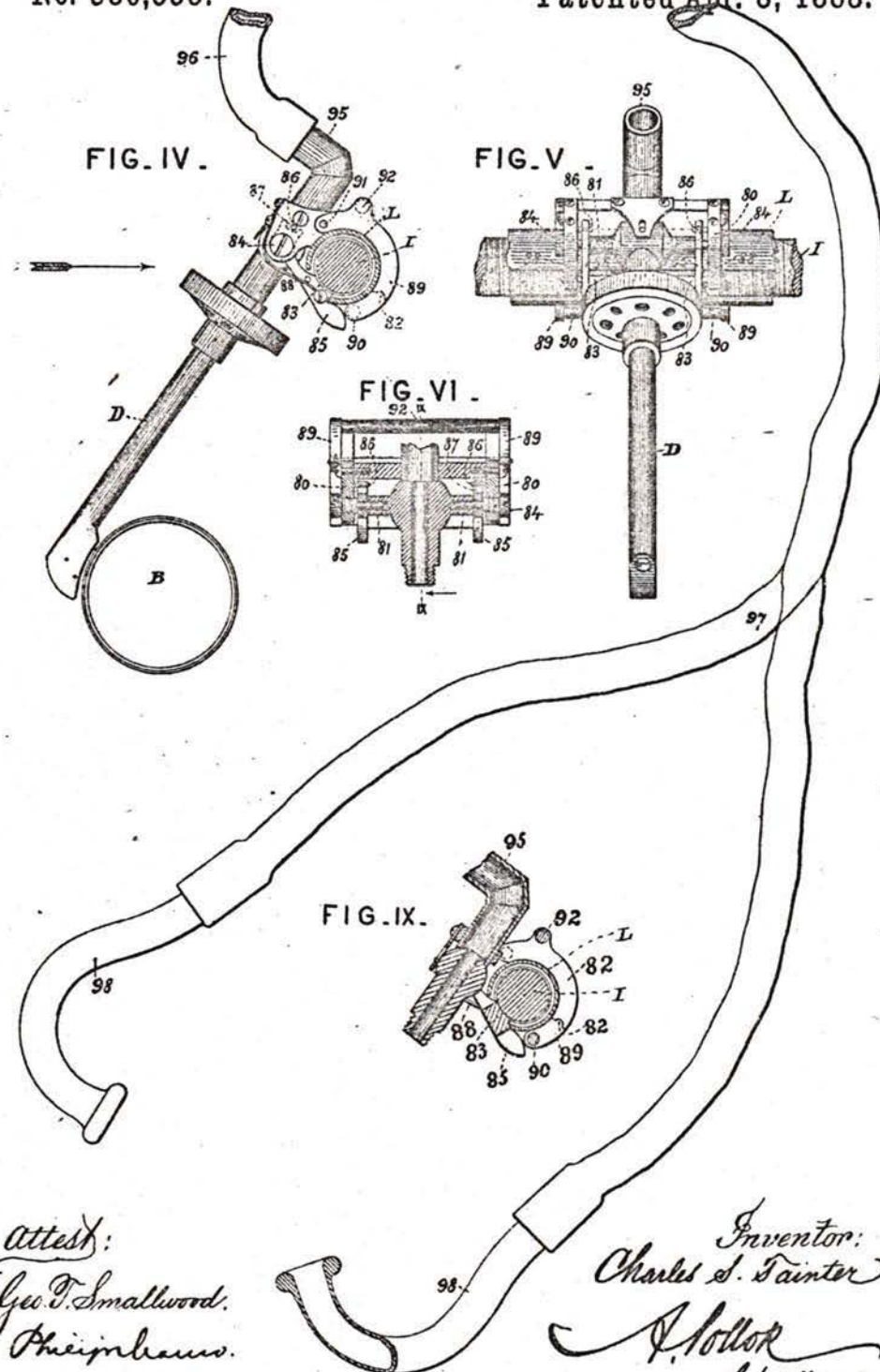
(No Model.)

C. S. TAITER.  
GRAPHOPHONE.

4 Sheets—Sheet 4.

No. 380,535.

Patented Apr. 3, 1888.



attest:  
Geo. T. Smallwood.  
Phoenician.

Inventor:  
Charles S. Tainter by  
A. Hollor  
his attorney.



# UNITED STATES PATENT OFFICE.

CHARLES SUMNER TAITER, OF WASHINGTON, DISTRICT OF COLUMBIA.

## GRAPHOPHONE.

SPECIFICATION forming part of Letters Patent No. 380,535, dated April 3, 1888.

Application filed December 2, 1887. Serial No. 256,814. (No model.)

### *To all whom it may concern:*

Be it known that I, CHARLES SUMNER TAITER, of Washington, in the District of Columbia, have invented a new and useful Improvement in Graphophones, which improvement is fully set forth in the following specification.

This invention has reference to the construction of graphophones, or apparatus for recording and reproducing speech and other sounds; and its general object is to improve such apparatus in point of efficiency, convenience in use, and simplicity of construction.

The invention may be regarded mainly as an improvement upon the apparatus described in Letters Patent No. 375,579, granted to me December 27, 1887, being similar thereto in general form and in many of its details.

In the present invention the machine is provided with two tablet-holders and with duplicate recording instruments, the latter being connected together by tubes leading to a common mouth-piece. This arrangement is very convenient for preserving copies, as of correspondence. The apparatus is so contrived that one or two records may be made, as desired.

I am aware that it has been proposed heretofore to provide a diaphragm with two styles on opposite sides thereof and acting upon different tablets, and therefore do not claim, broadly, the idea of making two or more records simultaneously.

According to the present invention there is no carriage forming a permanent part of the machine and serving both for recorder and reproducer, as in the patent referred to above. The recorder is now rigidly attached to a sleeve, which constitutes its carriage and encircles the guide-tube surrounding the feed-screw. This sleeve is divided longitudinally into two parts, and the parts are hinged together, so that the recorder can be readily put on and taken off the machine, as desired. The second recorder is provided with devices for suspending it from the same sleeve, it being preferably pivoted on the hinge-pintle of the sleeve itself. A spring-actuated segmental nut passes through a slot in the guide-tube and engages the feed-screw.

Heretofore the point of the cutting-style has been round or conical. As herein shown and

described, it is flattened on the sides, decreasing the amount of metal and facilitating construction of the point without diminishing its rigidity in the direction of its cutting action.

Heretofore in machines of this type a metallic tablet-holder of cylindrical form has been used to support the tablet, the holder being removable from the frame, so that the tablet can be slipped on and off. According to the present invention the cylindrical tablet-holder is discarded, and the tablet is supported at the ends only, there being for that purpose two disk-shaped holders, having tapering sides, so that they enter the ends of the hollow tablet, and shoulders which bear against the ends thereof and hold it in place. One of the disk-holders is carried on a shank movable longitudinally and held in place by a spiral spring. It can be withdrawn to permit of insertion or removal of a tablet. This construction has several advantages. It effects a saving of the cost of the cylindrical tablet-holder, and it enables the tablets to be more quickly removed and replaced. Moreover, in the operation of the machine it is desirable in stopping to bring the tablet to rest at once, and as heretofore constructed the momentum of the metal tablet-holder was such as to carry the tablet forward a certain distance after disengaging the clutch. By the present construction this defect is remedied.

According to the present invention the reproducer is provided with a carriage whereby it can be hung upon the guide-tube and operated by the feed-screw. One essential of successful reproduction is steadiness as nearly absolute as is obtainable. By the construction hereinafter described the requisite rigidity and steadiness are secured, while at the same time the reproducer can be quickly put on and taken off the machine.

The invention comprises other new details of construction and combinations of parts, as hereinafter described and claimed.

In the accompanying drawings, which form part of this specification, Figure I is a plan view of the machine, showing the recorders in place; Fig. II, a cross-section partly in elevation, looking to the left, Fig. I; Fig. III, a sectional elevation; Fig. IV, a side elevation of the reproducer; Fig. V, a front view thereof; Fig. VI, a sectional plan of the same; Fig.



VII, a detail of the cutting style on an enlarged scale, and Fig. VIII an inside view of half of the sleeve constituting the recorder-carriage. Fig. IX is a vertical section illustrating the re-

5 producer-carriage.

The machine-frame comprises the uprights or standards E F and the tie-rods 20 21, connecting the same. The standards E F are also connected at the top by the tube L, which constitutes the guideway for the recorder and re-  
10 producer and incloses the feed-screw I. The two cylindrical tablets B B' are placed below the feed-screw I and are respectively in front of and behind the same. Pulley 25 drives the front tablet, B, while the rear tablet, B', is driven by pulley 26. The feed-screw I is driven by pulley 25 through the gears 27, 28, 29, 30, 31, and 32, the latter being mounted on the feed-screw.

20 The front tablet, B, is supported by the two disk-holders II H'. The former is mounted on the end of a sleeve, or hollow arbor, h, having a bearing on a hollow stud, 18, which passes through the standard E and is clamped in place by a nut, 43, as best shown in Fig. III. The sleeve h also carries the gear 27, through which motion is imparted to the train of gears operating the feed-screw I. The disk-holder II tapers slightly inward, so that it will readily  
25 enter the hollow tablet B, and it is provided with a shoulder, 34, against which the end of said tablet bears. The disk II is provided with points 14 to take into the ends of the tablet and prevent its slipping. The opposite disk-holder, H', is loosely mounted on the end of a shank, h', which passes through a tube, 35, rigidly secured to the standard F by clamp-nuts 36, the disk being held in place by a screw, 37, tapped into the end of shank h'.  
40 The shank h' is free to move longitudinally in the tube 35, and between its ends it is turned down to leave space between it and said tube for the spiral spring 38, which bears at one end against shoulder 39 on said tube and at the other end on shoulder 40 of the shank h' and tends to press the disk II' to the left—that is, toward the tablet B. A pin, 41, passing through a slot in tube 35, prevents rotation of the shank. By the pressure of spring 38 the  
50 tablet B is clamped between the two disks II H'. To remove the tablet it is only necessary to withdraw disk II' by taking hold of the button 42 on the end of shank h'. The operation of inserting and removing a tablet is thus very quickly performed. The holder II' receives no positive motion, but simply turns with the tablet B and disk II.

The rear tablet, B', is supported by holders H<sup>2</sup> H<sup>3</sup>, similar in construction to the holders H II', already described. The only difference in the parts is that holder H<sup>2</sup> has no gear-wheel corresponding to gear 27 on the hub h of holder II. These duplicate parts are inserted in the machine-frame and held by nuts  
65 43 44. The machine would be complete for the purpose of making a single record without

them, and they can be readily added at any time when desired.

The clutch mechanism is in general form similar to that described in the patent above 70 referred to. Certain modifications have, however, been made.

A rod, 50, passes through the rod 20 and carries on its left-hand end an upright finger, 51, which takes into a groove in an arbor, 52. 75 The arbor 52 passes through the hollow stud 18, which is slotted at 19 to admit of the passage and movement of finger 51. The arbor 52 carries on its outer end one member, 53, of the clutch, the other member, 54, being fixed 80 to the hub of driving-pulley 25. On the inner end of arbor 52 is fixed a disk, 55, which engages and drives the holding-disk II through a pin, 56, passing through a hole in said disk 55 and tapped into holder H. Rod 50 is 85 moved longitudinally by the key-lever 57, carried by rock-shaft 58, the latter being connected with rod 50 by a crank-arm, 59. When, by means of lever 57, rod 50 is moved to the left, arbor 52 is moved in the same direction, 90 disengaging the clutch, and pulley 25 can then turn in its bearing without rotating holder II and feed-screw I. In the other position of the clutch mechanism arbor 52 is connected with the pulley and is rotated thereby, driving 95 holder H through disk 55 and pin 56, and the feed-screw I through the train of gears already described. The rock-shaft 58 extends across standard E, and at its rear end is connected by a crank-arm, 59, with another rod, 60, passing 100 through tie-rod 21 and operating a similar clutch mechanism for the second tablet, B'.

The recorder C is rigidly attached to a sleeve, M, which constitutes its carriage, and is adapted to slide on guide-tube L. Sleeve 105 M is divided into two parts longitudinally, the parts being hinged together at 65. The interior of sleeve M is slightly larger than tube L, except at the ends, where rings 66, of hard rubber or like material, are inserted, the diam- 110 eter of the rings being such as to fit closely on tube L. This construction permits easy longitudinal movement of the carriage M and recorder or recorders carried thereby, while insuring rigidity of the latter against lateral 115 movement. Such rigidity is essential, and the speaking-tubes are in this case led from the mouth-pieces direct to the recorder, and unless the latter were rigidly supported an irregular line, and consequently a worthless 120 record, would be the result. It has been found that this mode of carrying the recorder has decided advantages in this respect over the plan of hanging it by trunnions from supports on a carriage. 125

The segmental nut 67 is carried on the end of a shank, 68, and is pressed by spring 69 into engagement with feed-screw I. The nut passes through the slot, which, as before, extends lengthwise of the tube L. The upper edge, 130 70, of this slot is rounded and the upper edge of nut 67 is beveled, so that the act of lifting



the recorder disengages the nut from the feed-screw and withdraws it from the slot. In putting the recorder in position the nut automatically snaps into place. A pin, 71, on the shank 68 passes through a slot in the frame of the recorder, limiting the movement of the shank and affording means for withdrawing the nut by hand. The counter-weight 72 is attached to the other half of the sleeve from that which carries the recorder C.

The second recorder, C', when in place is suspended by the semicircular hangers 73, attached by screws 74 to its frame. These pieces extend half-way around tube L, and their upper ends are pivoted on the hinge-pintles 65 of the hinges that connect the two parts of carriage M. When the second recorder is in position, it rests upon the tablet B', by which its weight is mainly supported. There is a tendency on the part of the recorder to slide off the tablet lengthwise of the recorder, and this strain comes on the sleeve and guide-tube; but since the hangers 73 extend half-way round the guide-tube L, the pull of the recorder in this direction acts on a line passing diametrically through the axis of the sleeve M, and hence the recorder C', when in position, does not tend to turn said sleeve.

Heretofore the point of the cutting-style c has been rounded. As shown in Fig. VII, it is flattened, being shaped like an arrow-head, slightly hollowed out on one edge. Styles of this shape are easier to make, while they lose no rigidity in the direction of their cutting action by the removal of metal from the sides. In all other respects the recorders are like that described in the patent referred to, and therefore no further description thereof is necessary.

The respective sound-chambers in the two recorders C C' are connected by tubes 75 76, joined at the middle with a T-shaped coupling-piece, 77, for attachment of a suitable mouth-piece, or of flexible tubes 78, such as described in said patent. Therefore on reaching the coupling-piece 77 the sound-waves are propagated in both directions through tubes 75 76, and duplicate records are thus produced, so that if letters are being dictated one record can be mailed to the correspondent and the other retained as a copy.

The reproducer D is shown in Figs. IV, V, and VI. The construction of the hollow standard and the mounting of the diaphragm and rubbing-style are as described in said patent, and therefore need no particular description here.

The carriage by which the recorder is supported and advanced in action consists, mainly, of a frame, 80, in which the trunnions 81 of the reproducer are pivoted at 84. Frame 80 has two curved arms, 82, the curvature of whose under sides corresponds with that of the guide-tube L. The segmental nut 83 is carried by two supporting-arms 85, which turn freely on the trunnions 81 of the recorder, their motion,

however, being limited by pins 86, attached to the frame 80 and engaged by the stops 87 on the ends of arms 85. Flat springs 88 press the nut 83 into engagement with feed-screw I. When the recorder is in place, and as the nut is diametrically opposite the curved arms 82, these parts hold the carriage in place on the guide-tube L. The nut can be moved outward against the pressure of springs 88 far enough to let the guide-tube L pass between it and arms 82. To secure the perfect rigidity and steadiness desirable, and to avoid the necessity of extra care on the part of the operator, the carriage is provided with a locking device, which consists of curved arms 89, connected at their lower ends by a tie-rod, 90, and near their upper ends by tie-rod 92, being pivoted at their upper ends to frame 80 by a pivot-pin, 91. The curvature of arms 89 corresponds with that of the guide-tube L, and when in place the arms drop by gravity into contact with said tube, their lower ends bearing against the same at a point diametrically opposite the pivot 91. These pivots should be placed at the point where a line drawn through the axis of the feed-screw I (or guide-tube L) would be intersected by a line perpendicular thereto drawn from the pivot 84. Any undue pressure exerted on the reproducer-carriage when in operation would tend to turn the whole device upon pivots 84 as a center, and hence said pressure would be effectually resisted by the whole strength of the locking-piece and guide-tube. If pivots 91 were shifted to one side or the other of the intersection of the two lines determined as above pointed out, it will be seen that the pull on the locking-piece would be in a line more or less oblique to the surface of the guide-tube L, and the liability of slipping would not be so effectually provided against.

Contact of the tie-rod 92 with the stationary arms 82 limits the movement of the locking-piece in one direction, and its movement in the other direction is limited by contact of the rod 90 with the end of said stationary arms. As in the case of the nut 67 of the recorder, nut 83 of the reproducer has a beveled upper edge, so that the reproducer and carriage can readily be removed from the machine, it not being necessary to withdraw the nut by hand.

A hollow metal tube or socket-piece, 95, is rigidly attached to frame 80 and communicates at its lower end with the hollow standard of the reproducer. To the upper end of socket 95 is attached the end of flexible tube 96, which bifurcates at 97 and has at the farther ends the ear-pieces 98. The latter are connected directly with the reproducer, instead of being led to a fixed metal tube, as heretofore; hence the necessity of the greater rigidity of the recorder-carriage secured by the construction just described.

Ear-pieces 98 have ends of a proper size and shape to enter the concha of the ear, and, being hook-shaped, can be hung from the ridge



known as the "anti-tragus," and do not require to be held in position by hand, by spring-pressure, or by suspending devices of any kind. This improvement is found to contribute greatly to ease and convenience in use.

Inasmuch as this improvement is applicable to apparatus other than graphophones, no claim thereto is made herein; but the same is reserved for a separate application.

The operation of the apparatus needs no particular description, being sufficiently obvious from the explanations already given, and being, moreover, similar to that of the apparatus described in the patent before mentioned.

It is obvious that modifications could be made in the details of construction of the several parts of the apparatus and that, if desired, some of the improvements described could be used without others without in either case departing from the spirit of the invention.

Having now fully described the said invention and the manner in which the same is or may be carried into effect, what I claim is—

1. In a graphophone, the combination, with the feeding and driving mechanism, of duplicate tablet-holders and duplicate recorders, each having a diaphragm and style, the air-chambers adjacent to said diaphragms being connected with a common speaking tube or passage, substantially as described.

2. In a graphophone, the combination of the duplicate tablet-holders and tablets, the feed-screw, the recorder-carriage adapted to be driven by said screw, and the two recorders, one for each tablet, both supported by said carriage and connected by a sound tube or passage, substantially as described.

3. In a graphophone, the combination, with the feed-screw and guide-tube, of holders for two tablets, one on each side of said feed-screw, the carriage adapted to slide on said guide-tube, and the two recorders hanging one on each side of said carriage, substantially as described.

4. In a graphophone, the combination, with the feed-screw and guide-tube, of the carriage comprising a sleeve in two parts hinged together and adapted to embrace said tube, substantially as described.

5. In a graphophone, the combination, with the feed-screw and guide-tube, of the carriage comprising a two-part sleeve, a recorder rigidly attached to said carriage, and a second recorder attached removably to said carriage, substantially as described.

6. In a graphophone, the combination, with the feed-screw and guide-tube, of the carriage comprising a sleeve divided lengthwise into two parts, said parts being hinged together, a recorder rigidly attached to said carriage, and a second recorder pivoted thereto at the

hinges connecting the two parts, substantially as described.

7. In a graphophone, the combination, with the feed-screw and inclosing guide-tube having a slot with curved edge, of the carriage having a segmental nut for passing through said slot and engaging said screw, said nut having a beveled edge, and a spring for holding said nut in engagement with said screw, substantially as described.

8. In a graphophone, the combination, with the driving mechanism and a hollow cylindrical recording-tablet, of a tablet-holder comprising two rotatable disks for clamping the tablet between them, substantially as described.

9. In a graphophone, the combination, with a hollow cylindrical tablet, of the two holding-disks bearing against opposite ends thereof, one of said disks being movable toward and away from the other, substantially as described.

10. In a graphophone, the combination, with a hollow cylindrical tablet, of the two holding-disks adapted to clamp the tablet between them, one of said disks being movable toward and away from the other, and a spring bearing on said movable disk, substantially as described.

11. In a graphophone, the combination, with the feed-screw and tablet-holder, and gearing for driving the former from the latter, of clutch mechanism comprising a rod passing through the bearing of said tablet-holder and adapted to lock the same to the driving-pulley or release it therefrom, substantially as described.

12. The combination, with the feed-screw and guide-tube, of the reproducer-carriage comprising a frame having curved arms, a segmental nut carried by pivoted arms, and a spring pressing the two parts together, substantially as described.

13. The combination, with the feed-screw and guide-tube, of the reproducer-carriage comprising the frame with curved arms, the nut on a pivoted support, and the curved locking device, substantially as described.

14. The combination, with feed-screw and guide-tube, of the carriage, the reproducer pivoted thereto, the nut on a pivoted support, and the locking device comprising semicircular arms pivoted to said frame at or approximately at the intersection of a line drawn through the axis of the guide-tube with a perpendicular line drawn from the pivot of said reproducer, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHARLES SUMNER TANTER,

Witnesses:

R. M. READ,  
PHILIP MAURO.





380  
(No Model.)

T. A. EDISON.

PROCESS OF DUPLICATING PHONOGRAMS.

No. 382,419.

Patented May 8, 1888.

Fig. 1.

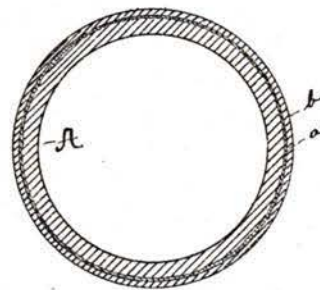


Fig. 2.

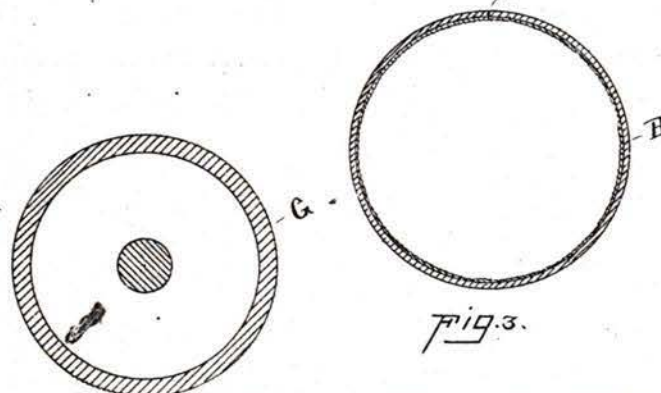


Fig. 3.

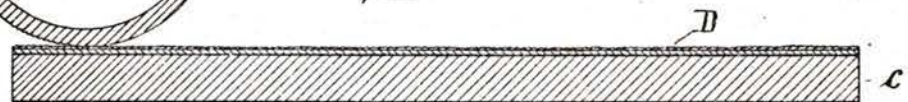
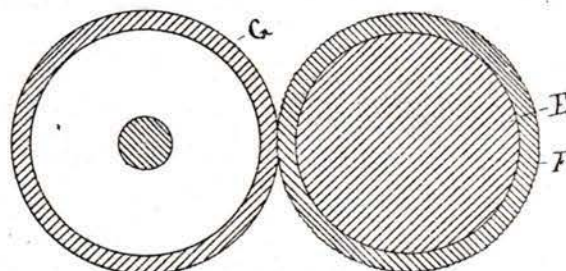


Fig. 4.



Witnesses  
E. C. Townsend  
William Rizer

Inventor,  
Thomas A. Edison.  
By his Attorney *John S. Long*



# UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

## PROCESS OF DUPLICATING PHONOGRAMS.

SPECIFICATION forming part of Letters Patent No. 382,419, dated May 8, 1888.

Application filed March 8, 1888. Serial No. 266,596. (No model.)

*To all whom it may concern:*

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Processes for Duplicating Phonograms, (Case No. 765,) of which the following is a specification.

The object of my invention is to produce a simple and efficient process for duplicating phonographic records. In applications already filed by me I describe a process for duplicating phonograms, wherein a metallic matrix is formed by depositing metals over the surface of cylindrical wax phonograms and then dissolving out the wax, leaving a hollow matrix or mold with the record in relief upon its inner surface. By my present invention I propose to apply the process of knurling to the duplication of phonograms as distinguished from molding. In my English Patent No. 1,644 of 1878 I proposed to construct a knurl by depositing metal over the record; but it is obvious that if this deposit were made of any thickness at all the record would be largely obliterated.

By my present invention I deposit metals over the record of the recording surface of a cylindrical wax phonogram, and after melting out the original wax I divide the remaining cylinder by splitting it longitudinally with a thin saw on one side. I then open the cylinder out flat or further bend it into the form of a cylinder, with the record upon its exterior. To give the necessary strength I provide a suitable backing. The result is a flat or cylindrical knurling surface having the record in relief, so that by rolling a wax phonogram-blank upon it the original record will be reproduced.

For making the first deposit upon the original wax phonogram I prefer to employ silver, which is deposited upon the wax phonogram by the vacuum process or by electroplating. A thin coating is produced in this way, which is backed up by a coating of lead or tin, which is also quite thin. For example, it may be one-sixteenth of an inch in thickness. The silver gives an inoxidizable surface, which is cheaper than gold or platinum. After the wax is dissolved out and this cylinder split on one side it will be found to have sufficient flexi-

bility by reason of the materials employed and the thinness of the cylinder to permit of its being bent without injury to the record into the form of a flat sheet or a reversed cylinder. If bent around a cylinder it will be secured to the same by cement, and if bent into a flat sheet it will likewise be secured to a suitable bed-plate, the cylinder or bed-plate giving the necessary strength to the record. The duplicate phonogram-blanks upon which I impress the original record by means of the knurl are preferably of a wax composition, which is too hard to be practically indented directly in the phonograph, although softer compositions may be employed, or materials other than wax.

In the accompanying drawings, forming a part hereof, Figure 1 is a sectional view showing the original phonogram with the deposit thereon; Fig. 2, a similar view with the original phonogram melted out or removed from the encircling metal deposit. Fig. 3 is a sectional view illustrating the flat knurling surface, and Fig. 4 a similar view illustrating the cylindrical knurling surface.

A is the original wax phonogram, upon the surface of which is the phonographic record, upon which is formed a thin deposit of silver, *a*, and over this a thicker deposit of lead or tin, *b*, the entire metallic deposit being, for illustration, one-sixteenth of an inch thick. After this deposit is made the wax cylinder A is melted out of the metal coating, leaving the metallic cylinder B (shown in Fig. 2) with the record in relief upon its inner surface. This cylinder B is split longitudinally on one side at the point *c*, and it is then bent out flat and mounted upon a suitable base-plate, C, to which it is secured by cement, forming a flat knurling surface, D; or the cylinder B may be bent reversely over a solid cylinder, E, and secured thereto by cement, forming a cylindrical knurl, F. (Shown in Fig. 4.) The wax duplicate phonogram-blank G is impressed with the original record by rolling it against the flat or the cylindrical knurling surface, as will be readily understood.

I do not claim herein the method of duplicating phonograms by depositing metals upon a cylindrical wax phonogram and then melting or dissolving out the original wax phonogram, leaving a matrix with the record in relief upon its inner surface; neither do I claim



herein the use of a vacuum deposit for producing a coating upon the wax phonogram; neither do I claim herein a duplicate phonogram constructed of a hard material not capable of being satisfactorily indented by a phonograph, since these features are covered in my applications Nos. 743, 744, and 751, already filed by me. Such applications have respectively the Serial Nos. 259,895, 259,896, and 262,428.

What I claim as my invention is—

1. The process of duplicating phonograms, consisting in forming a knurl having the original record in relief by depositing metal upon the original record, removing the original phonogram and opening the metallic coating, and then impressing duplicate phonogram-blanks with the original record by means of such knurl, substantially as set forth.

2. The process of duplicating phonograms, consisting in depositing a flexible metallic coating upon an original cylindrical phonogram, removing the original phonogram from the inclosing-coating, splitting the inclosing-coating longitudinally, bending the same to form a knurl, and then impressing the duplicate phonogram-blanks with the original record by means of this knurl, substantially as set forth.

This specification signed and witnessed this 3d day of March, 1888.

THOS. A. EDISON.

Witnesses:

WM. PELZER,  
E. C. ROWLAND.





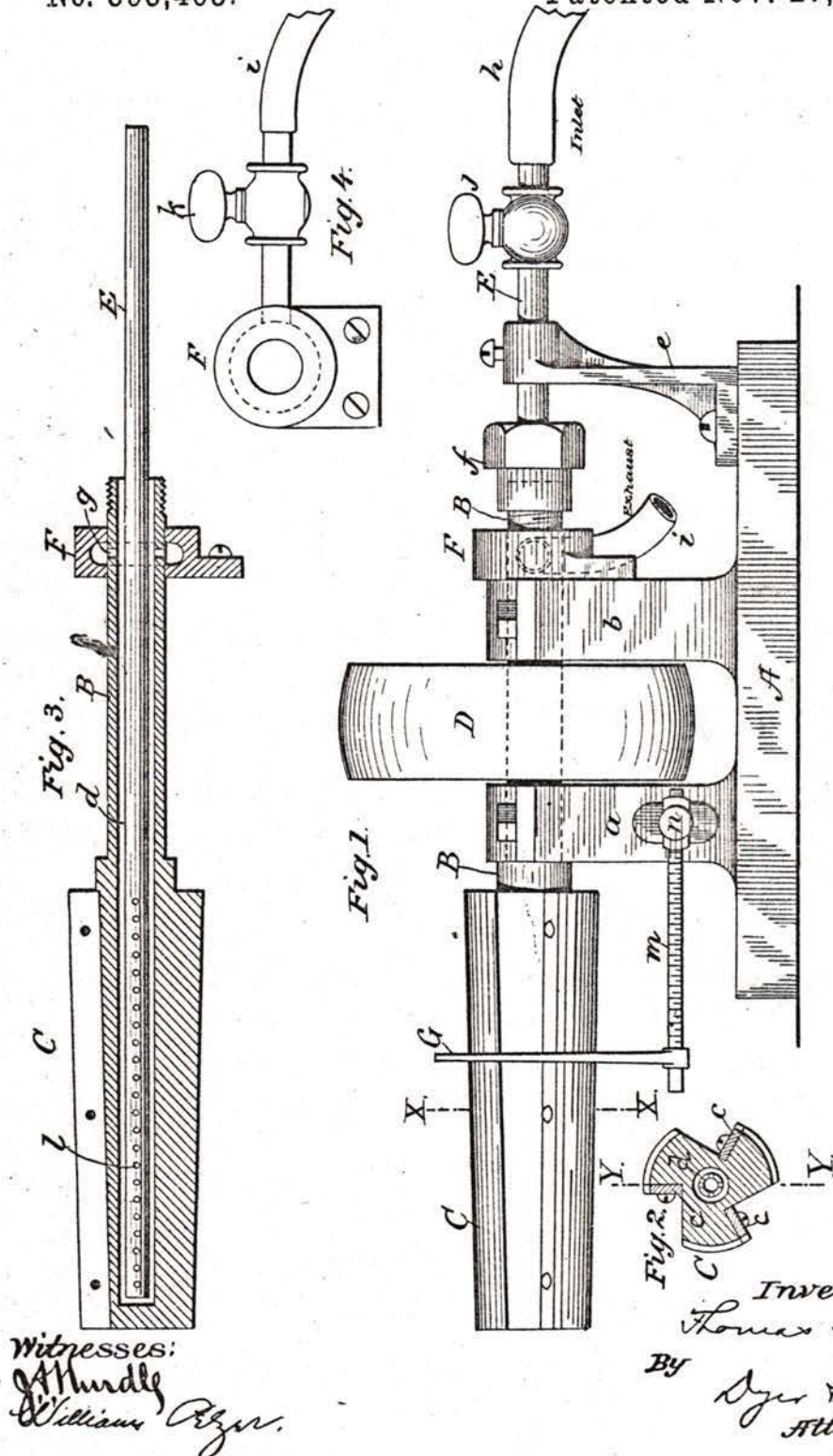
(No Model.)

T. A. EDISON.

MACHINE FOR MAKING PHONOGRAM BLANKS.

No. 393,463.

Patented Nov. 27, 1888.



Witnesses:  
*J. Hurdle*  
*William R. Rye*

Inventor:  
*Thomas A. Edison*  
 By *Dyer & Seely*  
 Attorneys.



# UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY, ASSIGNOR TO THE  
EDISON PHONOGRAPH COMPANY, OF NEW JERSEY.

## MACHINE FOR MAKING PHONOGRAM-BLANKS.

SPECIFICATION forming part of Letters Patent No. 393,463, dated November 27, 1888.

Application filed May 7, 1888. Serial No. 273,039. (No model.)

### *To all whom it may concern:*

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Machines for Making Phonogram-Blanks, (Case No. 769,) of which the following is a specification.

As has been made known by my prior applications for patents, the phonogram-blank which I prefer to employ is one made entirely of wax or a wax composition in the form of a cylinder having a cylindrical outer surface and a tapering bore. These blanks I first mold from the wax or wax composition; but owing to the excessive contraction of the wax in cooling the blanks are somewhat distorted and do not have the accurate shape and size required. Hence it becomes necessary to mold the blanks slightly larger than the size for the finished blanks and then to reduce them by cutting to the proper size and shape, both externally and internally. I have found that the use of the ordinary cutting-tools at ordinary temperatures for this purpose is objectionable. In my application of even date herewith, (Case No. 768, Serial No. 273,038,) I have described a method of finishing these blanks consisting in cutting them externally and internally with heated knives or cutters.

The object of my present invention is to provide a proper tool for reaming out the wax phonogram-blank, so as to make its bore accurately of the size and shape desired.

In the accompanying drawings, forming a part hereof, Figure 1 is a side elevation of the improved reamer. Fig. 2 is a cross-section on the line *x x*. Fig. 3 is a longitudinal section through the reamer and its shaft on the line *y y*; and Fig. 4 is an elevation of the exhaust-outlet for the heating medium.

A is a suitable base or table, from which rise pedestals *a b*, in which is journaled the shaft B, carrying the tapering reamer C. Upon the shaft between the pedestals is the pulley D, by means of which power is applied to the reamer for revolving it rapidly. The reamer C is made tapering, it having the exact size and shape it is desired to give the bore of the wax phonogram-blank. It is provided with cutting-knives *c*. The shaft B and reamer C are made

hollow, the passage or channel *d* extending entirely through the reamer, but being closed at the small end of the reamer. Into the channel *d* is introduced centrally a stationary pipe, E, which is rigidly held by a bracket, *e*, rising from the base A, out of contact with the sides of the channel *d*, so that the reamer C and shaft B can be revolved while the pipe E is held at rest. The shaft B terminates between the pedestal *b* and bracket *e*, and is provided with a stuffing-box, *f*, which closes the opening *d* around the pipe E at this point. Secured to the outer face of the pedestal *b* is a box or chamber, F, which fits closely around the shaft B, such shaft being provided with a number of perforations, *g*, where it is covered by this box. The pipe E and the box F are connected with leading-pipes *h i*, provided with stop-cocks *j k*. A heating medium, which is preferably steam, but may be hot water or hot air, is supplied to the pipe *h* and passes into the pipe E at its other end within the reamer C, and then passes out of such pipe E through its open end and through the perforations *l* in such pipe E into the channel *d* around the pipe E, and thence returns through such channel *d* to the perforations *g*, and out of such perforations into the box F, and thence out by the pipe *i*, the flow of the heating medium being controlled by the stop-cocks *j k*. Thus the reamer can be maintained at the precise temperature desired.

To determine the extent to which the wax phonogram-blank will be pushed upon the reamer, I provide a gage-arm, G, which passes over the reamer and is screwed to an arm, *m*, held by a set-screw, *n*, to the side of the pedestal *a*. By means of the set-screw *n* the gage-arm G can be set to any point desired. The arm *m* may have a scale marked upon it to indicate the position to which the gage-arm is set. This enables me to ream out phonogram-blanks of different lengths.

The hollow cylindrical wax phonogram-blanks are taken in the hand and are pushed onto the reamer and withdrawn from it by a continuous motion, the reamer being brought up to the desired temperature and the combined action of heating and cutting rapidly and smoothly reaming out the bore of the blank.

The wax blanks are preferably heated by a



hot table, oven, or chamber approximately to the temperature of the reamer before being cut by the reamer, in order to prevent cracking by unequal expansion.

5 What I claim as my invention is—

1. A revolving reamer having cutting knives or edges, and provided with means for heating it, substantially as set forth.

10 2. A revolving reamer having cutting knives or edges, and made hollow, in combination with pipe connections for introducing a heating medium into the hollow reamer, substantially as set forth.

3. The combination, with a revolving shaft, B, and reamer C, made hollow, of a stationary 15 pipe, E, and the box F, substantially as set forth.

This specification signed and witnessed this 28th day of April, 1888.

THOS. A. EDISON.

Witnesses:

WILLIAM PELZER,  
A. W. KIDDLE.





386

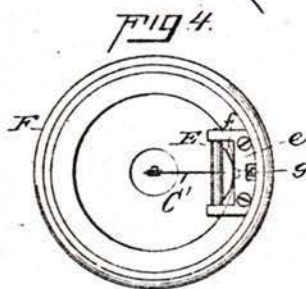
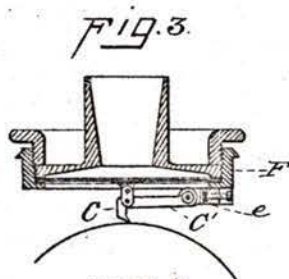
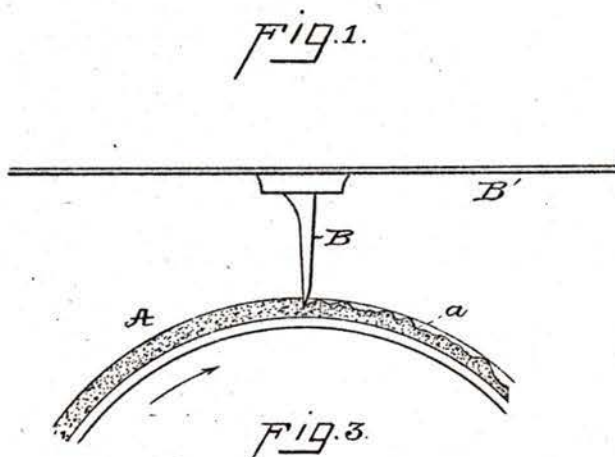
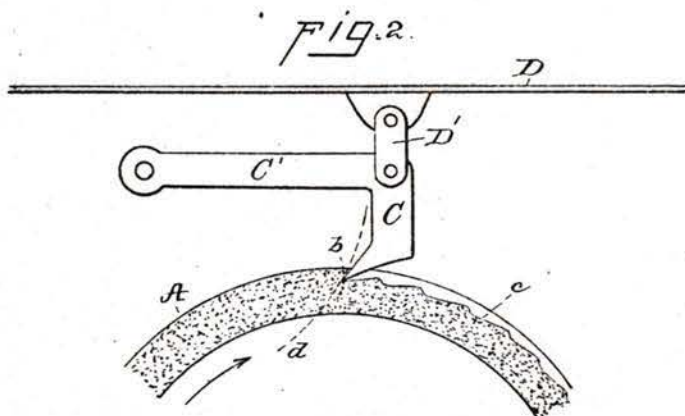
(No Model.)

T. A. EDISON.

METHOD OF RECORDING AND REPRODUCING SOUNDS.

No. 393,967.

Patented Dec. 4, 1888.



WITNESSES:

*Ed. Rowland.*  
*William Pizer.*

INVENTOR.

*Thomas A. Edison.*  
BY *Dyer & Leely,*  
ATTORNEYS.

# UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

## METHOD OF RECORDING AND REPRODUCING SOUNDS.

SPECIFICATION forming part of Letters Patent No. 393,967, dated December 4, 1888.

Application filed July 17, 1888. Serial No. 280,209. (No model.)

*To all whom it may concern:*

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Phonographs, (Case No. 791,) of which the following is a specification.

For the recording-surface of my phonograph (*i. e.*, the phonogram-blank) I employ a solid material, such as a wax composition or a mixture of metallic soaps capable of being indented by the recording-point. In recording sounds a groove is formed in the material by means of an indenting-point connected with the diaphragm of the recorder, and this groove varies in depth accordingly as the indenting-point is advanced or withdrawn by the vibrations of the diaphragm, thus forming the wave-record from which the sounds are reproduced, as is well understood.

Heretofore the recording-point used has been constructed so that in forming the groove it removed the material by a scraping action. This was due to the fact that the advancing edge of the recording-style used was perpendicular to the recording-surface or receded from the perpendicular, the result being a scraping rather than a true cutting of the material. The scraping action I have found to be productive of false vibrations, which become a part of the record, and which are audible as scratching and other foreign noises when the sounds are reproduced. I have found that this difficulty is overcome by employing a recording-point made as a true cutting-tool with a cutting-edge in advance of the stock of the tool. It might be supposed that a cutting-tool would be unsuitable for the recording-point, and that the heel of the tool would strike the bottom of the groove and prevent the formation of a perfect record, or obliterate the record as made by smoothing or pressing out the indentations more or less; but I have found that the movement of the recording-surface is sufficient to keep the heel of the tool clear of the indentations. This adaptability of the cutting-tool form for the recording-point I consider is also due in a measure to the fact that the recording-point in my phonograph is arranged to act more or less obliquely to the recording-surface, so that

the recorded waves will begin gradually and end abruptly. This oblique movement may be accomplished in any of the ways described in my application No. 786, (Serial No. 280,204, filed July 17, 1888,) in which this particular matter is more fully explained. The recording-point in its forward movement advancing against the movement of the recording-surface, the cutting-tool will clear itself just to the extent that its movement advances from the perpendicular, and thus the speed of the recording-surface will be supplemented in the respect of serving to keep the heel of the tool clear by the oblique movement of the cutting-tool. The waves, being abrupt, need not be as deep, and hence there is less difficulty in clearing the tool.

In my phonograph the cutting-tool recording-point is carried by a lever which takes the lateral thrust of the tool and relieves the diaphragm of the strain due to that thrust. This carrying-lever is also pivoted so as to produce the oblique movement of the recording-point before referred to. It also is made light, is provided with friction-bearings to overcome the momentum of the diaphragm and attached parts and to take up lost motion, and it is also positively connected with the diaphragm by a pivoted link or other form of connection which will yield in the direction of the length of the lever, so as to prevent the straining of the diaphragm. While I prefer to employ these several details, yet it is evident that the cutting-tool can be used with phonograph-recorders of various constructions, and hence I do not wish that feature of my invention, except when specially indicated by the claims, to be limited to the details stated. The cutting of the record in the material of the recording-surface, instead of scraping it, makes a clean smooth record, free from imperfections, producing scratching or other foreign noises in the reproducer.

In the accompanying drawings, forming a part hereof, Figure 1 is a view, on an exaggerated scale, illustrating the formation of a record by a scraping-style, as heretofore. Fig. 2 is a similar view illustrating the use of this invention. Fig. 3 is a vertical section of my phonograph-recorder complete, and Fig. 4 is a bottom view of the recorder.

A is the recording-surface, which may be



considered as a wax composition capable of being indented by the recording point or style. It is given a movement in the direction of the arrows, Figs. 1 and 2.

5 Heretofore the recording-style B has had its advancing edge perpendicular to the recording-surface or receding from it, as shown in Fig. 1. This produced the record *a* by a scraping action. By my invention the recording-  
10 point C, Fig. 2, is a cutting-tool having a cutting-edge, *b*, in advance of the stock of the tool. This produces the record *c* by a true cutting action. The style B is attached directly and only to the diaphragm B', and  
15 hence the wave-record *a* is composed of waves having a symmetrical rise and fall with the deepest part of each wave at its center. The point C is mounted on a pivoted lever, C', connected with the diaphragm D by a piv-  
20 oted link, D'. The direction of movement of the cutting-edge of the recording-point C is described by the dotted circle *d*; hence it will be seen that the recording-point C acts obliquely to the recording-surface and pro-  
25 duces recorded waves, which begin gradually and end abruptly. It will be seen that such is the character of the wave-record *c*. By the movement of the recording-surface and the oblique action of the recording-point the heel  
30 of the cutting-tool, forming the recording-point, is kept clear in operation.

From the description that has already been given and an inspection of Figs. 3 and 4 it will be readily understood how my phono-  
35 graph-recorder is constructed. The lever C' is carried by a bearing-pin, E, which is pivoted in a yoke, *e*, secured to the annular frame F of the recorder. A spring, *f*, bears against the pin E, and is adjusted in its tension by a  
40 screw, *g*. This produces a friction at the bearings of the pin E, which overcomes the momentum of the diaphragm and attached

parts by retarding their movement, and also takes up all lost motion at the bearings. The spring-friction produces a non-resilient and  
45 constantly-acting retarding device. The pivoted link D' prevents the diaphragm from being strained by the differences in movement of the diaphragm and the recording-point by reason of the fact that the link, due to its  
50 pivots, yields in the direction of the length of the carrier-lever, while it forms a positive connection between the recording-point and the diaphragm.

I do not claim in this application the ma-  
55 chine or apparatus herein described, but only the method of operation, I having been required by the Commissioner of Patents to embody the apparatus in a separate applica-  
60 tion for Letters Patent.

What I claim is—

1. The method of recording sounds for re-  
production, consisting in impressing sound-  
vibrations upon a cutting recording-point and  
thereby cutting in the recording-surface the  
65 record corresponding to the sound-waves in contradistinction to the formation of such  
sound-records by a scraping action.

2. The method of recording sounds for re-  
production, consisting in impressing sound-  
70 vibrations upon a cutting recording-point, and directing the vibrations of such recording-point obliquely to the recording-surface and thereby cutting in the recording-surface a  
75 sound-wave record having waves more abrupt at one end than at the other in contradistinction to the formation of such sound-records by a scraping action.

This specification signed and witnessed this  
14th day of July, 1888.

THOS. A. EDISON.

Witnesses:

WILLIAM PELZER,  
A. W. KIDDLE.





(No Model.)

G. H. HERRINGTON.  
METHOD OF RECORDING SPEECH.

No. 397,856.

Patented Feb. 12, 1889.

Fig 1

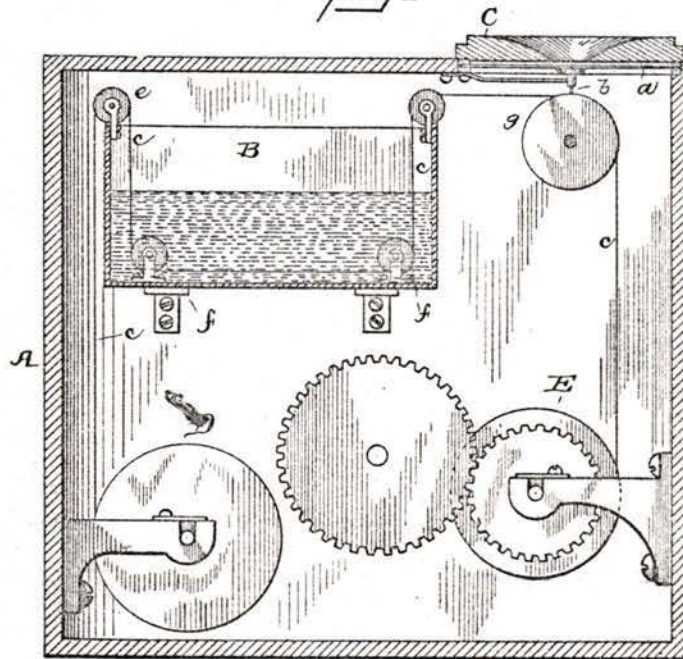


Fig. 2.

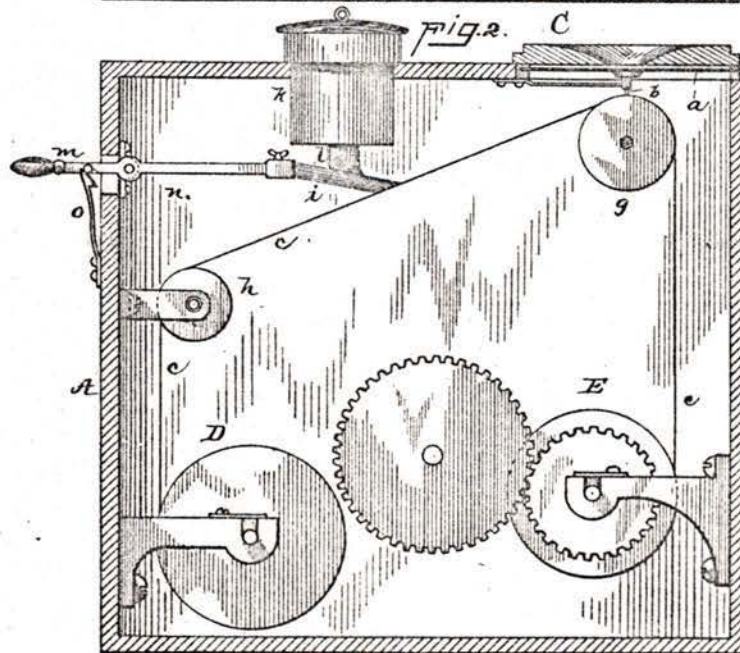


Fig. 3.

ATTEST:  
*Ed. Bowland,*  
*William O. Rye*

INVENTOR:

*George H. Herrington*  
*By J. S. Lacey*  
*att.*



# UNITED STATES PATENT OFFICE.

GEORGE H. HERRINGTON, OF WICHITA, KANSAS, ASSIGNOR TO HIMSELF, AND  
EDWARD H. JOINSON, OF NEW YORK, N. Y.

## METHOD OF RECORDING SPEECH.

SPECIFICATION forming part of Letters Patent No. 397,856, dated February 12, 1889.

Application filed June 18, 1887. Serial No. 241,795. (No model.)

*To all whom it may concern:*

Be it known that I, GEORGE H. HERRINGTON, of Wichita, in the county of Sedgwick and State of Kansas, have invented a certain new and useful Improvement in Phonographs, of which the following is a specification.

In my application filed September 11, 1886, is set forth a process of recording sound-vibrations by softening a material, passing it under the needle of a phonograph, and then allowing it to cool. In the application referred to I described the use as the recording medium of a material capable of being softened by heat and hardening when cooled.

My present invention relates to another specific process to the same end, one of whose advantages is that the appliances required for heating and cooling the material are dispensed with.

My improvement consists, mainly, in the employment as a recording medium of a material which is softened by a chemical solvent before passing under the vibrating needle, and afterward hardens as it dries.

I prefer to place the material upon the surface of a thin flexible strip, which is fed by suitable mechanism from a drum on one side of the apparatus to one on the other side, passing under the vibrating needle, and before reaching such needle coming in contact with the solvent. Suitable materials for the purpose are celluloid, glue, wax, molasses, pitch, asphalt, or various glutinous or resinous substances, or two or more of such substances in combination. A compound which I have found especially advantageous is one of celluloid mixed with a smaller quantity of molasses and beeswax, the celluloid and beeswax being dissolved with ether or other suitable solvents before mixing. This mixture I then spread evenly on a strip of paper or other suitable surface and allow it to dry hard, and then finish it with as smooth a surface as possible. Another combination which I have used to great advantage is one of glue, molasses, and wax, applied in a similar manner to that just described. This forms a particularly smooth and glossy surface, and prevents largely the harsh grating sound, which is an objection when tin-foil is used.

I employ solvents suitable for the particu-

lar material used. For instance, with celluloid I may use ether, with glue, and water, which may be heated; or with other materials alcohol, ammonia, or acetic acid, the proper solvent being employed for the material used, as will be readily understood.

Convenient apparatus for carrying my invention into effect is illustrated in the accompanying drawings.

Figure 1 illustrates a form of apparatus in which the strip is passed through a bath of the solvent. Fig. 2 illustrates a form in which the solvent is applied by means of a brush, and Fig. 3 is a view of a portion of the strip.

In Fig. 1, A represents a suitable inclosing box or case. B is a vessel containing the solvent. C is the mouth-piece or ear-piece, *a* the diaphragm, and *b* the vibrating point or needle. D is a spool or drum carrying the strip *c*, on which the sound-vibrations are to be recorded. This is a strip of paper or other suitable flexible material of sufficient strength for the purpose, and is covered with the soluble substance *d*. Fig. 3, such as above described. This strip passes over a roller, *e*, and then over the two rollers *f f* in the vessel B, under the surface of the liquid, then over the roller *g*, which brings it directly under the needle, and, finally, to the receiving drum or spool E, on which it is wound, this drum being revolved by a spring or any suitable motor, as indicated, so as to move the strip when in operation continuously along under the needle. As the strip passes through the solvent its surface is softened by the action thereof, so that it readily receives the impressions of the needle as it vibrates in accordance with sound-vibrations projected against the diaphragm. The drum E is placed at a sufficient distance, so that the surface dries before the strip is wound thereon. The surface of course hardens as it dries, so that the impressions remain permanently thereon.

The drums are preferably removable, so that the drum, with the record upon it, may be removed, and such record may be reproduced by placing the drum in a similar machine, of course with the solvent omitted, and passing it under the needle.

In the form shown in Fig. 2 the strip *c* passes from the spool D to the spool E under



the needle, as before. The vessel and the rollers therein are omitted, and the strip passes directly from a roller, *h*, supported on the side of the case to the roller *g* under the diaphragm. Between the rollers *h* and *g* a brush, *i*, rests lightly on the top of the strip. In this case this brush takes the place of the vessel of Fig. 1 as the receptacle for the solvent. A vessel, *k*, is supported by the top of the box, which vessel contains the solvent. From an aperture in the bottom of the vessel a porous body, *l*, which is preferably a mass of fibrous or spongy material—as wicking or sponge—hangs down and rests on the brush *i*, whereby the brush is kept constantly provided with the solvent. The traveling strip is therefore continually moistened with the liquid as it moves and reaches the needle, with its surface in the desired soft and impressible condition. I prefer to provide the brush with a handle, *m*, pivoted at *n* and passing through a slot in the side of the case, whereby when the machine is not in use, or when it is in use for reproducing sound, the strip may be removed from contact with the solvent by pressing down on the projecting handle. A spring-catch, *o*, is preferably provided for holding the brush away from the strip. The drum *E* is turned by a suitable motor, as before.

I do not claim herein the method of recording sounds by softening the recording medium, passing it through the recording-instrument while in such softened condition, and then allowing it to harden to set the impressions, since this is claimed in my prior application, filed September 11, 1886.

What I claim is—

1. The method herein described of making a permanent record of vibrations, which consists in softening a body of material by a chemical solvent, passing the same through the recording-instrument while it is in a softened condition, and then allowing it to harden.

2. The method of recording phonetic vibrations, which consists in covering a strip of material with a substance capable of being softened by a chemical solvent, subjecting said substance to the action of such solvent, passing it in its softened condition under the vibrating point of a phonograph, and afterward allowing it to harden to fix the phonogram, substantially as set forth.

This specification signed and witnessed this 13th day of June, 1887.

GEORGE H. HERRINGTON.

Witnesses:

RICHARD B. REILAY  
F. J. ARNOLD.

It is hereby certified that in Letters Patent No. 397,856, granted February 12, 1889, upon the application of George H. Herrington, of Wichita, Kansas, for an improvement in "Method of Recording Speech," an error appears in the printed specification requiring the following correction, viz: On page 1, in line 53, the word "and" should be stricken out; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 19th day of February, A. D. 1889.

[SEAL.]

D. L. HAWKINS,  
*Assistant Secretary of the Interior.*

Countersigned:

BENTON J. HALL,  
*Commissioner of Patents.*









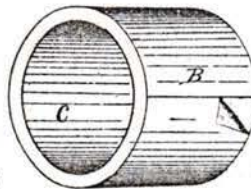
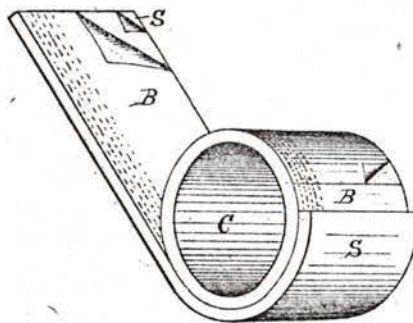
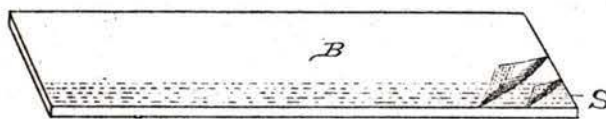
(No Model.)

G. H. HERRINGTON.

PROCESS OF DUPLICATING PHONOGRAMS.

No. 399,264.

Patented Mar. 12, 1889.

*Fig. 1.**Fig. 2.**Fig. 3.*

Witnesses,

F. E. A. Smith  
J. T. Cobb

Inventor,

George H. Herrington.  
By M. J. Hutchins  
Atty.

# UNITED STATES PATENT OFFICE.

GEORGE H. HERRINGTON, OF WICHITA, KANSAS.

## PROCESS OF DUPLICATING PHONOGRAMS.

SPECIFICATION forming part of Letters Patent No. 399,264, dated March 12, 1889.

Application filed September 21, 1888. Serial No. 285,977. (No model.)

*To all whom it may concern:*

Be it known that I, GEORGE H. HERRINGTON, a citizen of the United States of America, residing at Wichita, in the county of Sedgwick and State of Kansas, have invented certain new and useful Improvements in the Process of Making Duplicate Copies of Phonograms, of which the following is a specification, reference being had therein to the accompanying drawings and the letters and figures of reference thereon, forming a part of this specification.

This invention relates to certain improvements in the process of making duplicate copies of phonograms; and it consists, first, in preparing a phonograph-cylinder with a coating of wax or composition which is adapted to be softened by heat and become set and hard when cool; second, in covering said prepared cylinder with layers of tin-foil, upon which the phonogram-registrations are made while the wax or composition is soft; third, in covering said registered tin-foil with a coating of wax or composition which is adapted to be likewise softened by heat, and in removing said last covering, which serves as a matrix or shield for the tin-foil, together with one or more layers of tin-foil, when the said wax or composition is in a partially-cooled state, and in placing said matrix or shield with its layers of tin-foil upon a plane surface with the negative surface of its registrations presented, and, lastly, by making duplicate copies of the phonogram-record by rolling cylinders prepared with a coating of wax or composition across the surface of said registered foil, impressing positive characters of the phonogram-record in the surface of said cylinders while they are in a soft state, after which they are permitted to harden to retain the impressed characters, or the tin-foil may be removed from the matrix or shield and placed about a cylinder, and thus present the positive phonogram-duplicate upon the surface of said second cylinder, or in making casts of wax or composition when in a soft state in the form of sheets upon the negative surface of said registered tin-foil as it rests upon its matrix or shield, and applying said casts about cylinders while in a flexible state and permitting them to harden upon

their cylinders, and thus produce duplicate copies of the original phonogram. The duplicate copies of the original phonogram thus produced are adapted to be used in other phonographs or apparatus at distant places or at various places and times for reproducing the sound-vibrations of the original phonogram.

Figure I represents the cylinder of a phonograph, having a covering of either tin-foil, silver-leaf, or an equivalent material. Fig. II represents the process of making a reverse duplicate copy of a phonogram, and Fig. III represents the copying material after the impression is made and it has been removed from the cylinder.

Referring to the illustrations, C represents the cylinder of a phonograph.

B represents a thin sheet of either tin-foil, silver-leaf, or an equivalent material, and is shown in Fig. I as placed smoothly and closely about said cylinder, forming a surface upon which the phonogram is registered.

Referring particularly to Fig. II, the cylinder is shown with a covering of two or more thicknesses or layers of tin-foil, which have registered thereon the original phonogram. A covering or sheet of copying material, S, consisting of either wax, resin, pitch, celluloid, glue, rubber, or their compound or equivalent, which is adapted to be softened by means of heat or otherwise, is also shown as being impressed or formed with a duplicate negative copy of the original register and partially removed, removing with it one or more of the sheets of tin-foil, which have an impressed duplicate copy of the original register. Said copying material S, when applied in copying, is softened or used in a soft state and hardened or permitted to harden while in contact with the phonogram which it is copying, to insure perfect well-developed characters in the copy, thus forming a matrix or shield about said registered tin-foil before it is removed from the cylinder. After said material is removed from the cylinder with its impressed or formed characters, it is presented, as shown in Fig. 3, with a fine duplicate negative copy of the original phonogram upon its surface. By removing one or more layers of tin-foil from the original phonogram-cylinder with the matrix or shield it



is evident that the negative surface of the registrations of said foil will be presented, and their positive surface will be in contact with each other, with one in contact with the matrix or shield; and when said shield is in a hard state cylinders prepared with said wax or composition surface, when softened by heat, may be rolled across said registered foil with pressure sufficient to impress the registrations in the surface of said cylinders and closely press the tin-foil against them, and when said foil is permitted it will adhere to said cylinders and separate from its fellow layers and become the presented surface of the duplicate. If but a single layer of said registered foil is removed with the shield, the said foil may be treated with dilute glycerine or vaseline and duplicate copies produced, in the manner last described, excepting that the tin-foil will be permitted to remain in contact with its shield and the registrations made direct upon the surface of the duplicate cylinder.

The cylinder upon which the tin-foil is placed is first treated to either a coat of soft wax or with one or more of the said copying materials or their compound or equivalent; and when it is desired to register the phonogram thereon, if said coating is other than a soft material, it is softened by means of heat or otherwise, so it will properly receive and retain the register. If desired, soft wax may be employed for making duplicate copies of the original phonogram in a similar manner and in place of other material, as above stated. At times when it becomes necessary to remove the tin-foil from the cylinder having the original phonogram or from the copies thereof it may be done by treating the tin-foil with mercury without injury to the register.

One or more layers of thin tin-foil or an equivalent may be placed about the cylinder, and when the phonogram is registered thereon each layer of the tin-foil will receive and retain a duplicate copy thereof; also, the said register is impressed into the wax or composition on the cylinder beneath said layers of tin-foil.

When desired to prevent the tin-foil from sticking to the cylinder, so it may be easily removed, the cylinder is first subjected to dilute glycerine or vaseline on the face of the wax or composition. Said layers of tin-foil may be removed from the cylinder having the original phonogram thereon in duplicate pairs or singly; but before removing them they are covered with a coat or covering of either wax, resin, pitch, celluloid, glue, rubber, or their compound or equivalent, which is applied in a soft state and hardened or permitted to harden and form a shield to protect their register and form, after which they may be opened at their union, removed from the cylinder

having the original record, and placed or impressed about a second cylinder, and after they become properly impressed or seated upon said second cylinder said shield is removed, taking with it one or more of said sheets of tin-foil, and either leaving a covering of tin-foil having a duplicate record of the original phonogram thereon or impressing a duplicate copy of the original phonogram upon the surface of said second cylinder.

The object of this invention is principally to produce duplicate copies of original phonograms for the purpose of distribution or otherwise to reproduce the sound-vibration in a phonograph as registered on the original phonogram or any machine calculated to register the sound waves or vibrations, as in telegraphic, electric, and other minute operations of similar character; and the essential features of this invention consist in the use of tin-foil, silver-leaf, or some equivalent material for covering the phonograph-cylinders, and in the use of copying material, as above described, for receiving and retaining the copies in the manner stated.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. The herein-described process of making duplicate copies of original phonograms, consisting in preparing a phonograph-cylinder with a coat of wax or compound equivalent, in placing about said cylinder one or more layers of tin-foil, or an equivalent, thus forming a surface upon which to register the original phonogram, in covering said tin-foil having the original register thereon with a coat or covering of either wax, resin, pitch, celluloid, glue, rubber, or their compound or equivalent to form a shield to protect their impressed characters and form, and in removing said shield and tin-foil, and in placing or impressing said shield and tin-foil about a duplicate cylinder, in the manner substantially as and for the purpose specified.

2. The herein-described process of duplicating copies of phonograms, consisting in preparing a phonograph-cylinder with a coating of wax or composition which is adapted to be softened by the influence of heat, in placing layers of tin-foil or an equivalent about said prepared cylinder, thus forming a surface upon which to register the original phonogram, and in removing said layers of foil after the record has been made from the original cylinder and placing them about duplicate cylinders, thus forming duplicate copies of the original phonogram, substantially as and for the purpose specified.

GEORGE H. HERRINGTON.

Witnesses:

F. E. A. SMITH,  
J. G. BABB.





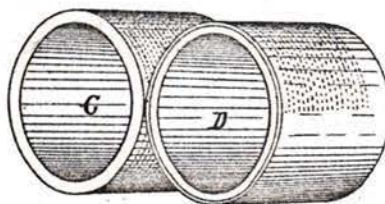
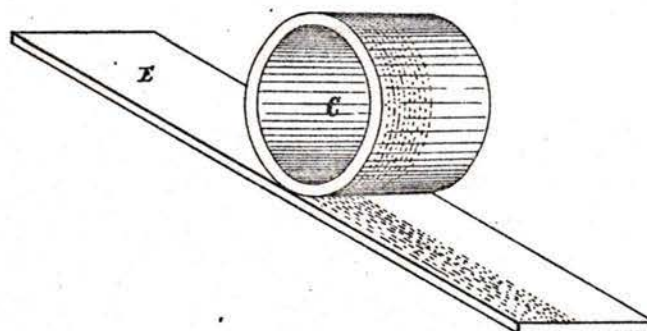
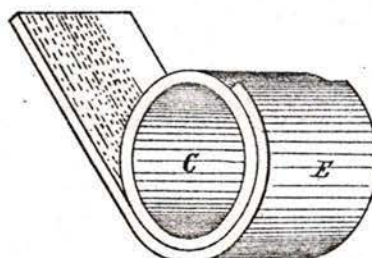
(No Model.)

G. H. HERRINGTON.

PROCESS OF DUPLICATING PHONOGRAMS.

No. 399,265.

Patented Mar. 12, 1889.

*Fig. 1.**Fig. 2.**Fig. 3.*

Witnesses.

J. E. A. Smith  
J. L. Bobb.

Inventor.

George H. Herrington.  
By *M. J. Hutchins.*  
Atty.

# UNITED STATES PATENT OFFICE.

GEORGE H. HERRINGTON, OF WICHITA, KANSAS.

## PROCESS OF DUPLICATING PHONOGRAMS.

SPECIFICATION forming part of Letters Patent No. 399,265, dated March 12, 1889.

Application filed September 21, 1888. Serial No. 285,978. (No model.)

*To all whom it may concern:*

Be it known that I, GEORGE H. HERRINGTON, a citizen of the United States of America, residing at Wichita, in the county of Sedgwick and State of Kansas, have invented certain new and useful Improvements in the Process of Making Duplicate Copies of Phonograms, of which the following is a specification, reference being had therein to the accompanying drawings and the letters and figures of reference thereon, forming a part of this specification.

This invention relates to certain improvements in the process of making duplicate copies of phonograms; and it consists, first, in preparing a phonograph-cylinder with a coating of wax or composition which is adapted to be softened by heat, in registering the sound-waves from a phonograph upon said prepared cylinder while its wax or composition is in a soft state, then in permitting said wax or composition to cool and harden and thus preserve its developed characters; second, in preparing sheets of said wax or composition, in softening said sheets by means of heat, and applying and pressing them about the cylinder having the original phonogram, or rolling said cylinder across said sheet with pressure to impress the phonogram-registrations upon the surface of said sheets, when the sheets are permitted to harden or set, and if about said cylinder removed, and thus said sheets are impressed with a negative duplicate copy of the original phonogram; and, third, in preparing duplicate cylinders with a coating of said wax or composition, and while they are in a soft state from the influence of heat they are either rolled across the sheet having the negative copy or said sheets placed about said cylinders, and in either instance pressure is applied sufficiently to impress a positive duplicate copy in the surface of said duplicate cylinders from the said negative copy. Then each is permitted to set or harden to preserve the duplicates thus obtained.

Figure 1 represents the process of copying the registrations of the sound-vibrations of an original phonogram upon the surface of a cylinder of similar dimensions by means of compression. Fig. 2 represents a similar process of copying said registrations upon a

plane surface, and Fig. 3 represents the process of copying said registrations upon a plane sheet of the copying material by means of placing said material about the cylinder having the original record thereon and by holding said material compressed thereabout until the characters are developed.

Referring to the illustrations, *c* represents a phonograph-cylinder having registered thereon the original phonogram.

*D* represents a cylinder of similar dimensions having a coat or covering of either wax, resin, pitch, celluloid, glue, rubber, or their compound, or some equivalent material adapted to be softened by means of heat or otherwise, so it will receive and retain the impression in reverse duplicate of the record made on the original phonogram by means of rolling the surfaces of the said two cylinders together with sufficient pressure to properly cause the record to be copied. (See Fig. 1.)

*E* represents a prepared sheet or plane surface of either wax, resin, pitch, celluloid, rubber, or their compound, or some equivalent material, as before stated, which is adapted to be softened by means of heat or otherwise and used in some instances in place of the cylinder *D* for receiving and retaining in reverse duplicate the record made on the original phonogram by means of rolling the cylinder having the original record over the surface of said sheet or plane with sufficient pressure to properly cause the record to be copied, as in the former manner, (see Fig. 2,) and thus by the process described a fine reverse duplicate or negative of the original phonogram is produced, and when the said copying material upon which the copy is made becomes cool it will set and become firm and retain a rigid copy. In instances where certain kinds of said copying material are used which will form into flexible sheets it is placed about the cylinder having thereon the original phonogram while soft and retained thereon by suitable pressure until the copy has been impressed and the material has become set and the several characters well developed. (See Fig. 3.)

To produce positive duplicates of the original phonogram, duplicate copying cylinders or sheets are prepared in like manner as above described and subjected to the same



process and pressure in contact with the cylinder or sheet having the reverse or negative copy of the original phonogram thereon, and when the positive duplicate copies of the original phonogram have set and their registrations have become firm they may be used in reproducing the sound-vibrations in a phonograph.

Any desired number of positive duplicate copies of the original phonogram may be made from the reverse or negative copy thereof in the manner and by the process stated. Duplicate positive copies of the original phonogram may be made from the reverse or negative duplicates thereof on soft wax.

The essential features of my invention consist in using one or more of the materials as follows: wax, resin, pitch, celluloid, glue, rubber, or their compound or equivalent, applied to a cylinder or roll or formed in plane sheet or strips, wherein they are adapted to be softened by means of heat or otherwise, so as to receive and retain, first, the reverse duplicate copy of the original phonogram, and, second, by using the said reverse duplicate copy for producing positive duplicate copies of the original phonogram.

The use to which this process of duplicating the registrations of the sound waves or vibrations is applied is in phonographs or any machine calculated to register sound waves or vibrations, as in telegraphic, electric, and other minute operations of similar character.

I am aware of the use of plastic material and materials adapted to be softened in various ways and impressed with characters and permitted to set or harden while in contact with the object of which the impression is taken; but I am not aware that the herein-described process has heretofore been used, wherein a phonograph-cylinder is first covered with a coating of wax or composition which is adapted to be softened by heat and the phonogram-record made thereon while said coating is softened from the influence of heat, then permitted to harden, then in preparing sheets or strips of said wax or composition material and applying said sheets in contact with the original recorded cylinder when in a soft state from the influence of heat, thus impressing said sheet with a negative copy of the original record, then permitting said sheet to set to preserve the form of its copy, and removing it apart from the original record and applying duplicate cylinders, which are prepared with a coating of said wax or composition, in contact with said negative copy of said sheet while said duplicate cylinders are softened from the influence of

heat, so they will receive in their surface an impressed positive duplicate copy of the original phonogram, and then permitted to harden to preserve such copy, thus producing any number of positive duplicate copies of the original phonogram-record in such form as that it may be used in reproducing the sound-vibrations in a phonograph.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows, to wit:

1. The herein-described process of making duplicate copies of original phonograms, consisting in preparing a phonograph-cylinder with a coating of wax or composition which will soften under the influence of heat, thus forming a surface upon which to register the phonogram when said surface is in a soft state, then permitting said recorded surface to harden, in applying a sheet or strip prepared from said wax or composition, while in a soft state from the influence of heat, in contact with said hardened recorded surface of the original phonogram, impressing said sheet or strip with said record, and while in such contact permitting the wax or composition to set, in removing said impressed sheet or strip from contact with the record, thus producing a negative duplicate copy, and in applying duplicate cylinders having a coating of said wax or composition in contact with said negative copy while the coatings of said cylinders are softened from the influence of heat, impressing in their surface a positive duplicate copy of the original phonogram from said negative, substantially as and for the purpose specified.

2. The herein-described process of making duplicate copies of original phonograms, consisting in pressing sheets of wax or composition which is adapted to soften from the influence of heat in contact with the original phonogram while in a soft state, then permitting it to set, thus impressing said sheet with the original record, in removing said sheet or strip from contact with the original record, thus forming a negative duplicate copy, and in applying duplicate cylinders having a coating of said wax or composition in contact with said negative copy while the coatings of said cylinders are softened from the influence of heat, thus impressing in their surface a positive duplicate copy of the original phonogram from the negative record, substantially as and for the purpose specified.

GEORGE H. HERRINGTON.

Witnesses:

F. E. A. SMITH,  
J. G. BABE.





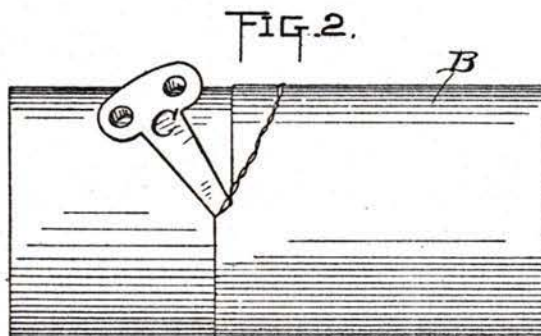
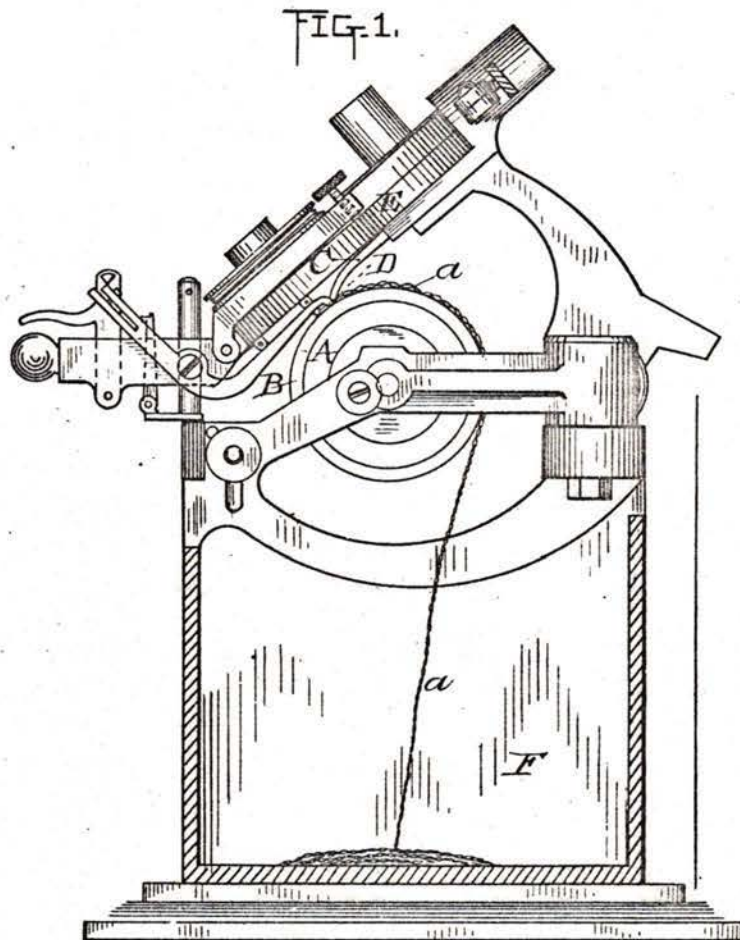
408

(No Model.)

T. A. EDISON.  
PROCESS OF TREATING PHONOGRAM BLANKS.

No. 406,571.

Patented July 9, 1889.



WITNESSES:

*A. Howlands*  
*W. E. G. Jr.*

INVENTOR

*Thomas A. Edison*

BY

*J. H. L.*

ATTORNEYS



# UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

## PROCESS OF TREATING PHONOGRAM-BLANKS.

SPECIFICATION forming part of Letters Patent No. 406,571, dated July 9, 1889.

Application filed February 11, 1889. Serial No. 299,454. (No specimens.)

### *To all whom it may concern:*

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Process of Treating Phonogram-Blanks, (Case No. 822,) of which the following is a specification.

My improved phonograph, as is well known, is provided with a turning-off tool for turning off the surface of the phonogram-blank. This is mounted, preferably, to operate with the recorder, so that the old record will be turned off at the same time that a new record is made.

For my phonogram-blank I employ a hard brittle material, such as a hard metallic soap or a mixture of wax with some hardening material. The chips which are produced in turning off such a blank have a high degree of electrification, which, I consider, is due to the rending of the material. They adhere to the surface of the blank and interfere seriously with the action of the recorder. They also adhere to the adjoining parts of the machine, and when it is attempted to brush or blow them off of the blank they fly in all directions and cover surrounding objects. The harder the material of the phonogram-blanks the greater seems to be the electrification of the chips, and since such hard materials produce the most perfect records it will be seen that the difficulty is one of importance. How to overcome this obstacle has proved one of the most difficult problems to solve which I have met with in my work upon the phonograph. I have found that by applying to the surface of the blank just before turning it off a solution which will slightly dissolve the material of the blank, or which will produce a chemical reaction upon such surface, so as to soften and toughen the surface, a continuous chip will be produced by the turning-off tool, which has little or no electrification, or the electrification of which is less powerful than the weight of the chip, so that the chip falls into the receptacle beneath the blank and leaves the surface of the blank perfectly clean for the recording-point, the dust produced by which can be readily blown or brushed off of the surface. The action of the solution does not penetrate to as great a depth

as the turning-off tool, since the surface upon which the recorder acts must be of the hard material. My turning-off tool takes a chip about seven one-thousandths of an inch thick. The penetration of the solution to the depth of five one-thousandths of an inch, or even less, will be sufficient to accomplish the purpose. The chip is made continuous. It is wet, and hence not electrical. The surface upon which it falls as it leaves the point of the turning-off tool is the wet uncut and un-electrified surface, and the chip is made heavier by the absorption of the solution. All or part of these conditions may be instrumental in producing the result.

Instead of using a solution which attacks the surface of the blank and produces a tough film of the material of the surface itself, a coating may be applied which adheres to the surface and on drying produces a tough film which forms a part of the chip and serves to hold it together as a continuous strip, so that the weight of the chip will be greater than the electrification of its under surface.

The material employed to soften and toughen the surface of the blank will depend, of course, upon the composition of the blank itself. For blanks made from hard metallic soaps, which I prefer, I may employ a weak alkaline solution, such as a one-per-cent. solution of caustic soda. The strength of the solution will vary upon the depth of the chip and the nature of the substance acted upon. With blanks of the hard metallic soaps I have found that water may be employed, since such soaps seem to be slightly soluble. The weak alkaline solution or the water is applied with a sponge after the blank is placed upon the machine, the surface being completely wet with the solution and any surplus being removed, if necessary, by a dry sponge or piece of chamois-skin. When the surface is dry, the spectacle-frame carrying the turning-off tool and the recorder is lowered into position, when a record is made and the surface turned off simultaneously.

With phonogram-blanks of other substances or compositions solvents or softeners of the particular substances of the blanks will be employed.

To produce tough films upon the surface of the blanks many substances may be applied



to the blanks, such as gum-balata dissolved in bisulphide of carbon, or gun-cotton dissolved in acetate of amyle, or glue and water.

In the accompanying drawings, forming a part hereof, Figure 1 is a sectional view of the phonograph, showing the turning-off tool and recorder in position for operation; and Fig. 2 is a top view of the phonogram-blank and turning-off tool.

A is the phonogram-cylinder, upon which is the removable phonogram-blank B, made with a considerable body of the recording material, so that a number of records can be made upon it by turning off old records.

C is the turning-off tool, and D is the point of the recorder. The recorder and turning-off tool are mounted upon the spectacle-frame E and are brought into operation at the same time.

The surface of the phonogram-blank is treated as has been explained. The chip produced by the turning-off tool falls into the receptacle F.

What I claim as my invention is—

1. The process of treating phonogram-blanks having hard brittle surfaces, consisting in producing a tough film upon the surfaces of such blanks preparatory to turning them off, substantially as and for the purpose set forth.

2. The process of treating phonogram-blanks having hard brittle surfaces, consisting in applying to such blanks preparatory to turning them off a solution which attacks the substance of the blanks and softens and toughens the surface, substantially as and for the purpose set forth.

This specification signed and witnessed this 1st day of February, 1889.

THOMAS A. EDISON.

Witnesses:

W. PELZER,  
D. H. DRISCOLL.





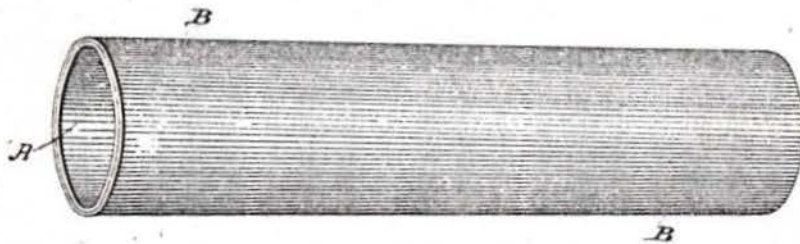
410

(No Model.)

No. 421,450.

C. S. TAITER.  
GRAPHOPHONE TABLET.

Patented Feb. 18, 1890.



Attest:  
Geo. P. Smallwood.  
Philip H. Hays

Inventor:  
Charles Sumner Tainter by  
Holt  
his attorney

# UNITED STATES PATENT OFFICE.

CHARLES SUMNER TANTER, OF WASHINGTON, DISTRICT OF COLUMBIA.

## GRAPHOPHONE-TABLET.

SPECIFICATION forming part of Letters Patent No. 421,450, dated February 18, 1890.

Application filed November 14, 1887. Serial No. 255,082. (No specimens.)

*To all whom it may concern:*

Be it known that I, CHARLES SUMNER TANTER, of Washington, in the District of Columbia, have invented a new and useful Improvement in Graphophonic Tablets, which improvement is fully set forth in the following specification.

This invention has reference to the preparation of a recording surface or medium for graphophones or apparatus for recording and reproducing speech and other sounds wherein the sound-record is cut or graven by a cutting-style in a surface, such as wax or waxy composition. For a description of such apparatus reference may be had to Letters Patent No. 341,214, dated May 4, 1886, No. 375,579, dated December 27, 1887, and No. 341,288, dated May 4, 1887.

The recording medium or composition is spread in a thin layer on a suitable base or foundation—such as paper or pasteboard—constituting what is termed the “tablet.” The form of the tablet is usually either cylindrical or flat, though of course they could be of other forms, and the shape of the tablet forms no part of this invention.

There are certain properties or characteristics in the recording medium that are desirable or essential to the successful operation, and which are difficult, owing to their somewhat contradictory nature, to find combined in one substance. It is necessary that the substance be of the right degree of hardness and toughness without being brittle, and that it should not be susceptible to changes of temperature. Some waxes are too brittle, and instead of cutting smoothly and accurately under the cutting-style chip or break off, producing, of course, an inaccurate record. Even a slight degree of brittleness will unfit the substance for the use designed, and as a general rule those waxes that are sufficiently hard and fine in texture for the purpose have also the undesirable property of brittleness and lack toughness and coherence. Other waxes—such as beeswax, for example—while cutting smoothly and evenly, are too soft and too susceptible to alternations of conditions under changes of temperature. Such waxes also become sticky, the shavings adhere to the record and other parts of the machine, and their use is attended with other inconveniences.

Soft waxes, moreover, do not give in reproducing as loud or distinct articulation as harder waxes.

Heretofore a composition of beeswax and paraffine has been used with good results, but it does not possess the essential characteristics in as high degree as desirable.

I have found after a long series of experiments that a certain natural or earth wax known as “ozocerite” is eminently suitable for the purpose of forming graphophonic recording-surfaces, particularly when treated as hereinafter described. This wax is tough and smooth in texture. In recording it cuts out in a continuous shaving without breaking into short pieces or adhering to the tablet or other part of the machine, and it cuts off close to the point of the cutting-style without chipping off below the same, and therefore produces an accurate record. In color it is brownish black in its crude state, but when treated as hereinafter described it becomes quite black and has a glossy surface and is opaque. This characteristic of color is useful, as it makes the lines of the record more distinct. On a light-colored surface the fine lines are very difficult to recognize. Defects or irregularities in the paper base or foundation, which are discernible through a semi-transparent wax, are completely hidden by the ozocerite.

In making a tablet the wax surface is applied by melting the wax and applying it while in a fluid state. On cooling the wax contracts more than the paper foundation, and on this account many of the compositions tried have cracked on cooling, rendering the tablet useless. The use of the ozocerite wax, however, is not attended with this disadvantage.

In forming a tablet with ozocerite wax it is advantageous to concentrate the crude wax by the application of heat until it loses from ten to thirty per cent. of its weight, which renders it much more suitable for the purposes of the invention. After concentration by boiling it becomes harder and tougher, changing in color from a brownish black to a deep black. It is then applied in a thin layer or coating to the foundation of paper or other material, and on cooling is turned down until a perfectly smooth surface is obtained.

In heating the ozocerite wax a high tem-



perature is necessary, in order to produce the concentration desired. At 250° Fahrenheit the vaporization proceeds very slowly, and it is customary to employ a temperature of 400° Fahrenheit and upward. The duration of the treatment will, of course, depend on the temperature employed.

The ozocerite wax may be employed alone, and it is sufficiently cheap for the purpose. It may, however, be combined with other waxes. It mixes readily with beeswax, carnauba-wax, and others, and its use in such compositions would be within the scope of the invention.

In the drawing, which is a perspective view, I have shown, by way of example, a cylindrical tablet. A is a base of paper or other suitable material, which may be constructed, as described, in my patent, No. 374,133, dated November 29, 1887. B represents a coating or layer of ozocerite wax. The latter having been concentrated, as before explained, is applied to the tablet in any suitable way. This may be done by immersing the tablet in the

liquefied wax a number of times until a coating of sufficient thickness is obtained. The wax coating is then turned down until the surface is perfectly smooth. It is not necessary that the coating B should be more than one-fiftieth of an inch in thickness.

I claim—

1. A tablet for graphophonic records, having a recording-surface consisting, essentially, of ozocerite wax, substantially as described.

2. A tablet for graphophones, comprising a foundation of paper or other suitable material having a surface coating of concentrated ozocerite wax, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHARLES SUMNER TANTER.

Witnesses:

R. M. READ,  
PHILIP MAURO.



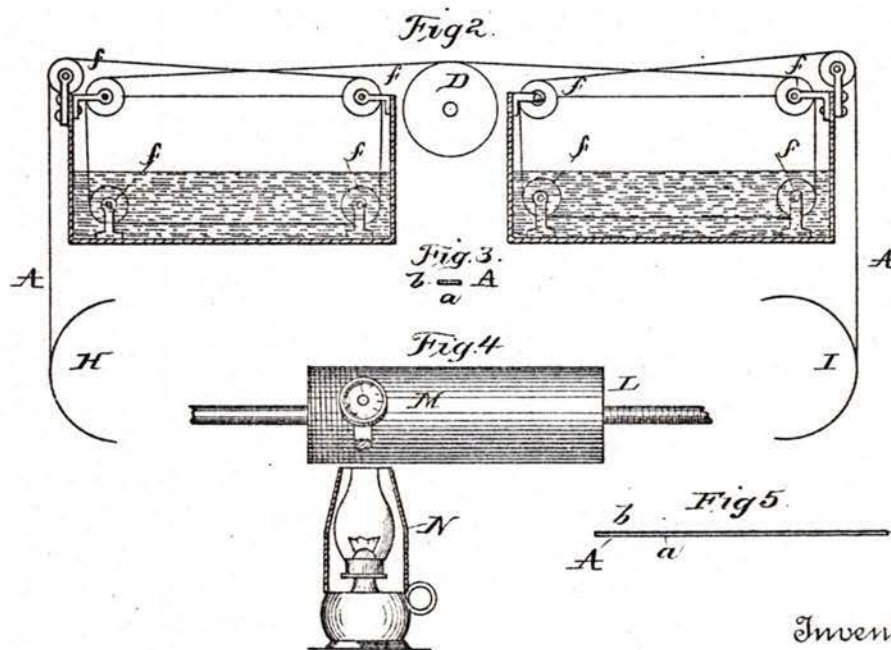
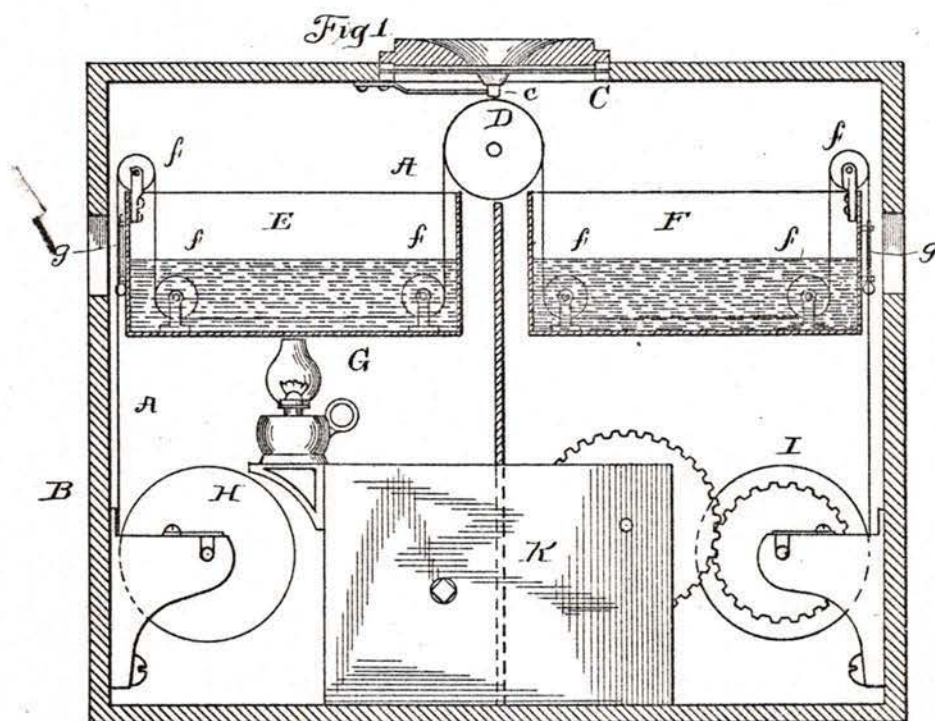


(No Model.)

G. H. HERRINGTON.  
PHONOGRAPH.

No. 464,476.

Patented Dec. 1, 1891.



Witnesses  
*E. Rowland,*  
*William Eger.*

Inventor  
*George H. Herrington*  
 By his Attorneys *John S. [Signature]*

Correction in Letters Patent No. 464,476.

It is hereby certified that Letters Patent No. 464,476, granted December 1, 1891, upon the application of George H. Herrington, of Wichita, Kansas, for an improvement in "Phonographs," were erroneously issued to said Herrington as sole owner of the invention; that said Letters Patent should have been issued to said *George H. Herrington and Edward H. Johnson, jointly*, each being owner of one-half interest, as shown by the record of assignments in this Office; and that said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 8th day of December, A. D. 1891.

[SEAL.]

CYRUS BUSSEY,

*Assistant Secretary of the Interior.*

Countersigned:

W. E. SIMONDS,

*Commissioner of Patents.*





# UNITED STATES PATENT OFFICE.

GEORGE H. HERRINGTON, OF WICHITA, KANSAS.

## PHONOGRAPH.

SPECIFICATION forming part of Letters Patent No. 464,476, dated December 1, 1891.

Original application filed September 11, 1886, Serial No. 213,278. Divided and this application filed August 22, 1888. Serial No. 283,459. (No model.)

### *To all whom it may concern:*

Be it known that I, GEORGE H. HERRINGTON, of Wichita, in the county of Sedgwick, in the State of Kansas, have invented a certain new and useful Improvement in Phonographs, of which the following is a specification.

In my application filed September 11, 1886, Serial No. 213,278, of which this application is a division, is set forth and claimed a method of recording sound-vibrations, in which the recording medium is first rendered plastic, then passed under the vibrating point or needle of the recording-instrument while in such plastic condition, and finally allowed to harden to set the impression and produce a permanent record. My present invention relates to the apparatus for carrying this method into effect, which apparatus is shown and described, but not claimed, in the application referred to, I having been required by the Commissioner of Patents to embody the apparatus in a separate application.

In carrying my invention into effect I employ as a recording medium to receive the needle-indentations a material capable of being softened or made plastic and of afterward becoming hardened. I cause such surface to receive the indentations while in its softened or plastic condition, and it retains them when it becomes hard again. I prefer to employ a substance, such as boiled tar, pitch, resin, asphalt, dental wax, or similar hard substances or compounds which become plastic when heated, and by the employment of heat I soften to the desired degree this surface as it passes under the point of the diaphragm-needle, and then by cooling harden the surface to give the record permanency. The heat-affected medium is preferably applied as a coating to a suitable supporting-thread, strip, or sheet of metal, fabric, paper, or rubber, and this supporting-body is also preferably flexible, so as to be readily wound upon spools and passed around wheels or drums. The recording-surface may also be covered with an extremely thin metallic foil or be powdered to prevent sticking to the needle or to the wheels or rollers while in a plastic condition. The heat may be applied in any suitable way, and air, water, or steam

may be used, the recording medium passing through a heating-chamber or over or around heating drums or rolls just before reaching the diaphragm-needle. The cooling may be effected by an air or water chamber, or by drums, or by other suitable means.

The phonograph may have a motor to move the recording medium under the point of the diaphragm-needle, and the same machine may, by the removal of the heating and cooling devices, be used to reproduce sound from such a record as has been described.

The same method and essentially the same apparatus can be employed for recording the movements of telephonic or telegraphic apparatus, so as to register messages sent by such instruments without departing from the spirit of my invention.

In the accompanying drawings, forming a part hereof, Figure 1 is a vertical section of a simple form of apparatus, illustrating the invention. Fig. 2 is a similar view of some of the principal parts of a modified form of apparatus. Fig. 3 is a cross-section of the recording-strip used with the apparatus of Figs. 1 and 2. Fig. 4 is a side elevation and partial section illustrating the application of the invention to the ordinary form of phonograph, and Fig. 5 is an edge view of a recording-sheet such as would be used with the apparatus of Fig. 4.

The recording strip A or sheet A' has a flexible body a, of thin metal, fabric, paper, rubber, or other suitable material, provided with a surface b of the recording medium, such as boiled tar, pitch, resin, asphalt, hard dental wax, or other similar substance or compound, and this surface may or may not be powdered or covered with extremely thin metallic foil, as before set forth.

In the apparatus shown in Figs. 1 and 2 a suitable box or frame B is provided for supporting and inclosing the parts. The ordinary phonograph-diaphragm C is supported in an opening in the top of this box, and beneath the diaphragm is the needle c, mounted in the ordinary way. Directly below the needle c is the roller D, over which the recording-strip A passes in a suitable guiding-groove, this roller serving to bring the recording-strip into contact with the point



of the diaphragm-needle. Heating and cooling chambers E and F are supported in the box B on opposite sides of the roller D, and are provided with wheels or rollers *f* for guiding and directing the recording-strip. A lamp G is shown for heating the chamber E and the recording-strip passing through it. Thermometers *g* are shown, by which the temperature of the chambers E F can be seen and regulated. Rollers H I carry the recording-strip, and a motor K gives the necessary movement to the strip.

In Fig. 2 the wheels or rollers *f* of the heating and cooling chambers are arranged so that in passing around them the recording-surface of the strip will not touch these wheels or rollers.

In Fig. 4 an ordinary phonograph-cylinder L is shown upon which the sheet A' is placed. The phonograph mouth-piece is shown at M. A lamp N is shown for heating the recording-surface of the sheet to a plastic condition as it passes under the diaphragm-needle. The recording-surface is cooled by the air as it passes from the influence of the lamp.

The recording medium is made as plastic as possible without injury as it passes under the diaphragm-needle, thus giving the greatest possible freedom of movement to the diaphragm, while the subsequent cooling by the atmosphere or artificially gives the recording medium a permanent hardness. When a message or communication has once been registered on the strip or sheet by a phonograph, telephone, or telegraph instrument, it can be repeated any number of times and can be handled without injury to the impressions and sent to any distant point to be repeated without the aid of a skillful operator at that point.

By removing the lamp or other heating medium the same apparatus may be employed to reproduce the sounds by running the strip

or sheet under the diaphragm-needle, so that its point will follow the sound-wave impressions or indentations.

It will be understood that I do not limit myself to the use of any particular material or compound as a recording medium, as any material or compound may be employed which when heated is sufficiently yielding or plastic to readily receive impressions and which will set and retain the impressions when cold.

What I claim is—

1. The combination, with a phonograph diaphragm and needle, of a traveling recording medium composed of a material or compound capable of being made plastic by heat, and means for heating and cooling such medium, substantially as set forth.

2. The combination, in a phonograph, of a strip or sheet phonogram-blank having a flexible body and a covering or surface of a material or compound capable of being made plastic by heat, and means for heating said material or compound, substantially as described.

3. The combination, with a phonograph diaphragm and needle, of a traveling recording strip or sheet having a flexible body and a surface of a material or compound capable of being made plastic by heat, and means for heating and cooling the surface of such strip or sheet, substantially as set forth.

4. The combination, with a phonograph diaphragm and needle, of a traveling recording medium capable of being made plastic by heat, a motor for moving such medium, and means for heating and cooling such medium, substantially as set forth.

This specification signed and witnessed this 2d day of August, 1888.

GEORGE H. HERRINGTON.

Witnesses:

JOHN P. ROGERS,  
A. T. OWEN.





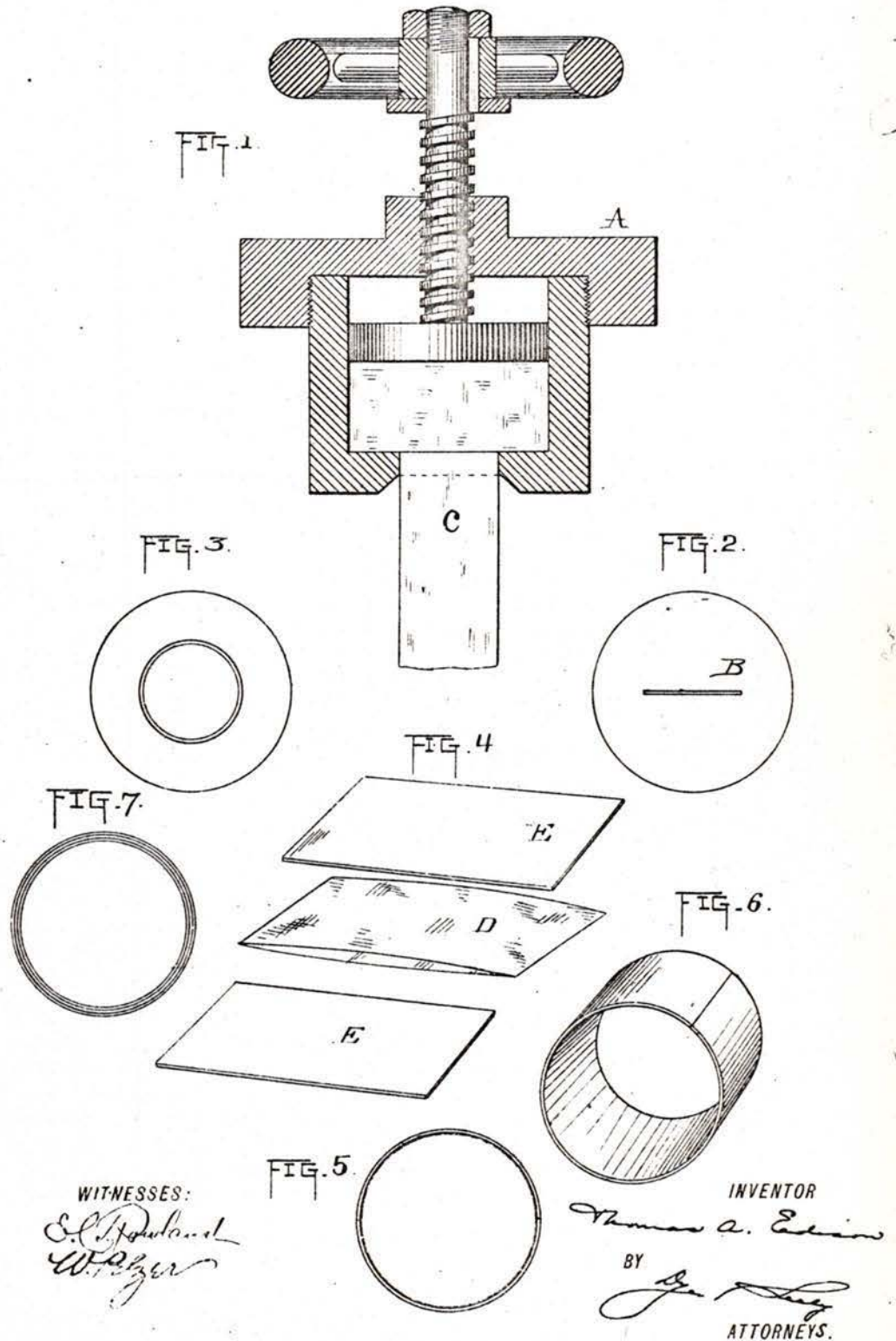
420

(No Model.)

T. A. EDISON.  
PHONOGRAM BLANK.

No. 488,191.

Patented Dec. 20, 1892.





# UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

## PHONOGRAM-BLANK.

SPECIFICATION forming part of Letters Patent No. 488,191, dated December 20, 1892.

Application filed January 19, 1889. Serial No. 296,876. (No model.)

### *To all whom it may concern:*

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Phonogram-Blanks, (Case No. 812,) of which the following is a specification.

The object of this invention is to provide  
10 phonogram blanks or surfaces for receiving sound records in the phonograph, which shall be of a convenient and simple form and can be cheaply and readily manufactured, and which will be adapted to be conveniently  
15 packed in boxes and inclosed in envelopes for transmission by mail.

The main feature of the invention consists in the use of thin flexible sheets of wax or wax like material, which sheets either by  
20 themselves or combined with backings of other suitable material, are used as the recording mediums in phonographs. I may form such sheets of plastic flexible material, by rolling or pressing such material into sheets, but I  
25 prefer to produce them by forcing the material through an aperture of the desired form in a press. The sheets thus formed may be used in a variety of ways. Such sheets may themselves form flat recording surfaces for  
30 the phonograph, or they may be attached to backings of paper or similar flexible material and used as flat recording surfaces, or they may be formed into cylinders, either with or without an internal backing of paper or like  
35 material, or they may be placed upon rigid cylinders and used in the phonograph, or used in various other ways.

There are many compounds of wax or wax like material which may be employed for the  
40 purposes of my invention. What I prefer to use is a mixture of asphalt with Japap wax or pitches made from the distillation of fatty oils or combinations of fatty acids, any of which materials are equivalents of wax for the purposes of this invention. The propor-  
45 tions of the different substances will vary as the conditions differ and as sheets of different degrees of flexibility are required. Beginning with the asphalt alone, which is brittle even in thin sheets, the flexibility may be

brought to any desired degree by adding more or less of the Japan wax or equivalent flexible substance.

My invention is illustrated in the accompanying drawings:

Figure 1 illustrates the use of the squirting  
55 press for forming the thin sheets. Figs. 2 and 3 are bottom views of different forms of the press; Fig. 4 shows the preferred method of placing such thin sheets upon a paper back-  
60 ing; Fig. 5 illustrates a cylinder thus formed; Fig. 6, a cylinder formed from the plastic sheet alone; and Fig. 7 shows a cylinder formed of a number of plastic sheets which are intended to be torn off as they are used.

A quantity of the material, such as above  
described, is placed in the press A in the bottom of which is usually a slot or elongated aperture B, (Fig. 2.) The material is raised to  
70 such temperature as will insure its easy passage through the aperture, and the pressure is then applied, and the material forced in the form of a thin sheet C through the aperture, as illustrated in Fig. 1. I prefer to allow it to pass directly into water, so as to set  
75 it immediately, and prevent distortion while it is in a heated condition. After it is dry, it may be coated with fine powder, such as talc or kaolin, to prevent the surface from adhering to other objects, and the strip which has  
80 come from the press is then cut up into sheets of the required size. These sheets may, as above stated, be used in many different ways. The sheet may be bent around a forming cylinder and the ends overlapped and pressed  
85 together, the surplus material being removed by a cutting or scraping tool, or preferably the ends are made to meet and are joined together by the application of a heated wire or by the addition of a small amount of the softened material along the joint. By this means  
90 cylinders like that shown in Fig. 6 are formed. Instead of this however, a sheet of thin paper may be cut to the proper size and formed into a cylinder with its edges joined, and this cylinder is then collapsed into a flat double sheet  
95 as illustrated in Fig. 4, the collapsed cylinder being shown at D. The double sheet D is placed between two sheets E E of the flexible wax like material and the whole is submitted



to pressure. The backs of the sheets E, or the sheet D being previously moistened with a solvent of the flexible material, such as benzol, the sheets E are thus made to adhere firmly to the sheet D, whereby a collapsed phonogram blank is formed, which can be drawn out into a cylinder and placed upon the cylinder of the phonograph, or upon a false shell placed thereon. A cylinder drawn out into form for use is shown in Fig. 5.

Instead of a backing of paper, the thin flexible sheets formed into cylinders like Fig. 6 or used in sheet form, as flat recording surfaces, may be covered with a varnish, such as a solution of a suitable gum, like gum balata, in a solvent such as bi-sulphide of carbon. A number of sheets of this character can be formed into a composite cylinder as shown in Fig. 7, the different layers, one of which is affected at a time by the phonograph recorder, being torn off as they are used.

The squirting press may have an annular aperture as shown in Fig. 3, whereby the material may be forced out in the form of cylinders instead of in sheets.

What I claim is:

1. A collapsible phonogram blank consist-

ing of a cylinder of flexible material with separable sheets of flexible wax or wax like material placed thereon, substantially as set forth.

2. A composite phonogram blank, consisting of two or more separately removable layers of recording material, each layer being of such thickness that a record impressed on one layer will not be transmitted to a succeeding layer substantially as set forth.

3. A composite phonogram blank, consisting of a cylinder of two or more separately removable layers of recording material, each layer being of such thickness that a record impressed on one layer will not be transmitted to a succeeding layer substantially as set forth.

4. A phonogram blank having in combination super-imposed separable layers of flexible wax or wax like material, substantially as set forth.

This specification signed and witnessed this 10th day of January, 1889.

THOMAS A. EDISON.

Witnesses:

H. W. SEELY,  
W. PELZER.

296 Northern District of Illinois, }  
Northern Division. } ss.

Certificate of clerk:

I, Marshall E. Sampsell, Clerk of the Circuit Court of the United States for said Northern District of Illinois, do hereby certify the above and foregoing to be a true and complete transcript of the proceedings had of record in said Court and made in accordance with stipulation filed in the causes entitled National Phonograph Company, complainant vs. Lambert Company and Thomas B. Lambert, defendants,—Edison Phonograph Company complainant vs. Lambert Company and Thomas B. Lambert, defendants, as the same appear from the original records and files of said Court now remaining in my custody and control.

In testimony whereof I have hereunto set my hand and affixed the seal of said Court at my office in the city of Chicago, in said District, this 2nd day of March 1903.

MARSHALL E. SAMPSELL

[SEAL]

Clerk.

297 United States }  
Of America, } ss.

Citation, filed  
Feb. 24, 1903:

*The Persident of the United States to Lambert Company and Thomas B. Lambert:*

You Are Hereby Cited and admonished to appear in the United States Circuit Court of Appeals for the Seventh Judicial Circuit, in the United States Court House in the City of Chicago, State of Illinois, on the 26th day of March 1903, pursuant to an appeal duly taken by National Phonograph Company from a certain final decree made by the United States Circuit Court for the Northern District of Illinois, Northern Division, dismissing the bill and refusing to grant an injunction against you in a certain suit in equity No. 25789, wherein National Phonograph Company is the complainant and you, Lambert Company and Thomas B. Lambert are the defendants; and you are also admonished, upon your appearance, to show cause, if any there be, why the said Circuit Court for the Northern District of Illinois, Northern Division, shall not be directed to vacate said decree and grant the injunction and relief prayed for in complainant's bill of complaint in said suit.

Witness the Honorable Melville W. Fuller, Chief Justice of the Supreme Court of the United States, this 24th day of February in



Citation, filed  
Feb. 24, 1903.

the year of our Lord one thousand nine hundred and three and of the Independence of these United States the one hundred and twenty-seventh.

KOHLSAAT

*U. S. Judge.*

Due service of the foregoing citation upon Lambert Company and Thomas B. Lambert is hereby acknowledged this 24th day of February, 1903.

THOMAS FRANCIS SHERIDAN

*Solicitor for Lambert Company and  
Thomas B. Lambert.*

(Endorsed) Circuit Court of the United States, Northern District of Illinois, Northern Division. Filed Feb. 24, 1903. Marshall E. Sampsell, Clerk.

298 United States }  
of America. } ss.

*The President of the United States, to Edison Phonograph Company, Greeting:*

You are hereby cited and admonished to be and appear at a United States Circuit Court of Appeals, for the Seventh Circuit, to be holden at Chicago, within thirty days from the date hereof, pursuant to an Order allowing an appeal entered in the Clerk's Office of the Circuit Court of the United States for the Northern District of Illinois, Northern Division, wherein the Lambert Company and Thomas B. Lambert are appellants, and you are appellee, to show cause, if any there be, why the decree rendered against the said appellants should not be corrected, and why speedy justice should not be done to the parties in that behalf.

Witness the Honorable Christian C. Kohlsaat, Judge of the District Court of the United States, this 24th day of February, in the year of our Lord One Thousand Nine Hundred and Three.

KOHLSAAT, J.

Service accepted this 24th day of February, 1903.

(Endorsed) Circuit Court of the United States, Northern District of Illinois, Northern Division. Filed Feb. 24, 1903. Marshall E. Sampsell, Clerk.

ISHAM, LINCOLN & BEALE

*Solicitor for Complainant.*